THE PHILIPPINE
JOURNAL OF SCIENCE
D. GENERAL BIOLOGY, ETHNOLOGY,
AND ANTHROPOLOGY

VOL. VIII FEBRUARY, 1913 No. 1

THE CIGARETTE BEETLE (*LASIODERMA SERRICORNE* Fabr.) IN THE PHILIPPINE ISLANDS

By CHARLES R. JONES

(*From the Entomological Section, Biological Laboratory, Bureau of Science, Manila, P. I.*)

Nine plates

INTRODUCTION

The cigarette beetle (*Lasioderma serricorne* Fabr.) has been prominent for many years as a destroyer of stored vegetable products and is one of the worst pests in the tobacco industry. Its ravages, especially to the manufactured product in tropical countries, are very large. The annual loss in Manila varies from 6,000 to 13,000 pesos (3,000 to 6,500 dollars United States currency) per factory for cigars actually destroyed in the factory alone. This represents but a small fraction of the real loss, for these figures do not include the shipments of infested cigars, which give a bad reputation to Manila cigars, and lead to a far greater loss to the factory than does any occasional loss of goods or damage due directly to the cigarette beetle.

The Insular Collector of Customs [1] shows a decrease in the exportation to the United States of tobacco and tobacco products from 4,023,404 pesos in 1910 to 1,483,544 pesos in 1911. The bulk of this decrease can undoubtedly be attributed indirectly to

[1] Annual report of the work of the Bureau of Customs during the fiscal year 1911.

the cigarette beetle. It is the purpose of this paper to bring together the principal facts concerning the life history,[2] the methods used, and the value of fumigants, etc., in the control of the pest.

The life history and habits of *Lasioderma serricorne* have been carefully studied and numerous experiments conducted with repellents, traps, and chemicals.

CLASSIFICATION AND SYNONYMY

This insect belongs to the family Ptinidæ, and was described from America in 1792 by Fabricius,[3] as *Ptinus serricorne*. Gemminger and Harold[4] give the following synonymy:[5]

Lasioderma serricorne FABR., Ent. Syst. (1792), 1, 241; MULS., Ann. Soc. Linn. Lyon (1864), 12, 1, Pl. 1, fig. 10. LEC., Proc. Acad. Nat. Sci. Phil. (1865), 238.

Lasioderma flavescens DAHLB., Dej. Cat. 3. ed. (1837), 129.

Lasioderma rufescens STURM, Cat. (1826), 206.

Lasioderma testaceum DUFTSCHM., Fauna Austr. (1859), 3, 46; STURM, Deutschl. Fauna (1837), 11, 89. pt. 237, fig. P. Q.

DISTRIBUTION AND DISSEMINATION

All of the principal tropical and subtropical tobacco-producing districts abound with the cigarette beetle. In Cuba and the Philippines it can be found at any season of the year. Its habits and food are such as to aid in its spread without much effort on the part of the insect. For short distances and in factories the beetle spreads by crawling and by flight, and it has been transported to all parts of the temperate and torrid zones with shipments of infested cigars and bales of tobacco, where it enters and deposits its eggs.

The cars, boats, and other vehicles carrying infested tobacco also become agents of dissemination. In March, 1911, on a trip to the Cagayan Valley in northern Luzon on a steamship, I found adults of the cigarette beetle abundant. This boat a

[2] In working out the life cycle in the laboratory, a check was carried giving the factory conditions, and it was found that these coincided with the laboratory experiments.

[3] *Entomologia Systematica* (1792), 1, 241.

[4] *Catalogus Coleopterorum* (1869), 6, 1781.

[5] For titles of articles dealing with the economy of the beetle, see Nathan Banks, Bibliography of American Economic Entomology. Div. Ent. U. S. Dept. Agr.

week previously had discharged a cargo of tobacco from the valley in Manila.

LIFE HISTORY

Feeding habits.—It does its chief damage to cigars and cigarettes by eating small holes through the wrappers. Some of the substances on which it has been found feeding are undoubtedly more or less accidental. I have found the cigarette beetle breeding in raisins, rhubarb, yeast-cakes, and tobacco, while Chittenden [6] reports it as infesting cayenne pepper, ginger, rhubarb, rice, figs, yeast-cakes, dried fish, silk and plush upholstery, ergot, turmeric, and tobacco in all forms. In 1895 it was reported as doing great damage to prepared herbarium specimens in Washington. Skinner reports it as breeding in the bran of pincushions and in pyrethrum powder strong enough to kill cockroaches. J. B. Smith [7] gives the following articles attacked: Dried roots and seeds of all kinds, cane and rattan work of all kinds, books, gun wads, hellebore, licorice, belladonna, and saffron.

Egg.—Because of the secluded places in which the eggs are laid, such as inside the filler, in small folds in the dried tobacco, within the open tip of the cigar or cigarette, or under the overlapping edges of the wrapper, they are very difficult to detect. Even in very badly infested stock I have found the eggs on the outsides of cigars only in a very few cases. Small particles of the paste used in cigar manufacture may be mistaken for the eggs of the cigarette beetle, and those who may be familiar with this insect in all its succeeding stages are frequently unfamiliar with the egg.

The egg (Plate I, fig. 1) is a whitish, opaque, round, elongated object pointed at one end, the other being rounded and covered for a short distance with minute spines; general appearance smooth, shell rather tough and not easily broken. Average length, 0.47 millimeter; width, 0.23 millimeter.

The eggs are laid during both the day and the night; the time of most active laying is in the early part of the evening. They are deposited singly in small folds and crevices of leaf tobacco, most frequently along the midrib. Egg-laying begins from two to five days after the emergence of the adult, if copulation has

[6] *Bull. U. S. Dept. Agr., Bur. Ent.* (1896), 4, 126; (1905), 54, 68.
[7] *Bull. N. J. Agr. Exp. Sta.*, Jan. (1907), 203, 35.

taken place. Unfertilized females apparently do not lay. Solitary females were kept from four to sixteen days in the laboratory without copulation and laid no eggs, while those that were allowed to copulate oviposited the first day afterwards. Egg-laying extends over a period of from six to eight days, gradually decreasing to the end. The maximum number of eggs is laid within three days after copulation.

The period of incubation of the egg varies greatly in the Philippines. Certain eggs have been observed to hatch within four days, while others kept under identical conditions took ten. There may be a variation of three days in the time required to hatch eggs laid by the same beetle on the same day. The average time required is six days. The following table shows the average length of the egg stage and the variation in hatching, from May to November, 1911:

TABLE I.—*Variation in incubation period of Lasioderma serricorne Fabr.*[a]

Date laid.	Hatchings.				Variation in hatching.	Average period of incubation.
	First.	Second.	Third.	Fourth.		
1911.					*Days.*	*Days.*
May 12	May 20				0	8
May 14	May 20	May 21	May 22		2	7
May 15	May 20	May 21	May 22		2	6
May 17	May 25				0	8
May 18	May 25				0	7
May 18	May 23	May 24			1	5.5
May 21	May 27				0	6
July 28	Aug. 5	Aug. 7			2	6.5
July 29 and 30	Aug. 4	Aug. 5	Aug. 6		2	6
August 6	Aug. 11	Aug. 12			1	5.5
August 7	Aug. 12				0	5
August 10 and 11	Aug. 17	Aug. 18	Aug. 19	Aug. 20	3	8
August 22	Aug. 26	Aug. 28	Aug. 30	Aug. 31	4	7
August 26	Aug. 31	Sept. 2			2	6
August 28	Sept. 2	Sept. 4			2	6
August 30	Sept. 2	Sept. 4	Sept. 6	Sept. 7	4	5.5
August 31	Sept. 4	Sept. 5	Sept. 6	Sept. 7	3	5.5
September 1 and 2	Sept. 6	Sept. 7			1	5
September 28	Oct. 2				0	4
November 19	Nov. 23	Nov. 24	Nov. 25		2	5.5
Average					2.2	6.1

[a] The eggs used in these tests were laid by different individuals, but were kept under the same conditions, and the record shows all eggs that hatched.

The percentage of eggs that do not hatch is very small. Experiments were conducted with 313 eggs, and of these only 14 failed, giving an average of 4.47 per cent.

Larva.—The larva (Plate I, fig. 2) hatches by eating its way through the large end of the egg, leaving an irregular hole in the shell. It is less than 1 millimeter in length and is covered with fine hair. The head is yellowish and the body semitransparent whitish or cream in older larvæ. The intestinal contents seen through the skin give it a dirty color, which varies with the quantity of food. It is a fleshy, wrinkled grub, its body usually curved. Fine particles of tobacco and dust, which adhere to the minute hairs on the body of the larva, often change its appearance to brownish. The young larvæ move about freely and, unless suitable food can be obtained, may wander to considerable distances. Each larva molts four or five times, then forms the pupal cell, and changes into a pupa. One larva was found to molt six times. The only change in appearance of the larvæ is in that of size. They develop slowly, requiring an average of fifty days in this stage. No descriptions or measurements were made of the larval stages. Daily observations were made and molts were recorded in the breeding experiments.

This insect damages cigars and cigarettes by eating small cylindrical galleries through the filler and circular holes through the wrapper. If the larva happen to get between two cigars, the wrapper of each may be slit lengthwise (Plate II, at "a"), but generally it bores straight through. Galleries, evidently made by a single larva, have been traced through three cigars. It is through the holes in the wrapper that the adults escape at maturity.

The method of attack upon leaf tobacco is similar in many ways to the attack upon cigars and cigarettes, the larvæ boring small round holes through the contiguous leaves. The greatest damage to leaf is apparently done to the first-grade wrapper. The finer and better qualities of tobacco afford better breeding conditions for the larva; hence the greater infestation in these grades. In many cases, first-grade wrappers must be used for filler, owing to the great number of small holes in it caused by the larvæ (Plate IX, fig. 1). Damage to the filler tobacco is less than to any other class, as this is of coarse texture and the attack made by the larvæ is generally along the midrib. The larvæ attack this part of the leaf, and do not feed promiscuously upon it as is the case in the finer grades of wrapper.

According to the general observations of those who are interested in tobacco and its products, infestation first appears in manufactured products on the higher and milder grades of cigars. The cheap grades and some of the strong *maduro* cigars often remain in the factories from one to two years without

becoming infested, while the higher and finer grades, such as Vegueros finos, Perfectos, Divinos, and Imperiales, show infestation within six or eight weeks. The same is true for cigarettes, the general or medium grades are less susceptible than such grades as Turkish or Sultanes. The injury done by the larvæ to the higher grade cigars and cigarettes is shown by Tables II and III.

TABLE II.—*Injury to different grades of cigars.*[a]

Date made.	Date examined.	Kind of cigar.	Number of boxes.	Number of cigars per box.	Total number cigars.	Number good.	Number infested.	Beetles—	
								Alive.	Dead.
	1911.								
1909	May 18	Londres	5	100	500	489	11	0	3
1910	July 27	Cazadores	6	50	300	0	300	66	149
Do	do	Cabinets	1	25	25	0	25	0	4
Do	do	Invictos	1	25	25	20	5	0	0
Do	do	Cesares	2	25	50	27	23	28	0
Do	do	Diputados	1	25	25	1	24	2	0
September to November, 1910.	July 27-29	Perfectos[b]	51	25	1,275	452	823	229	202
Do	do	Perfectos[c]	13	25	325	71	254	25	36
Do	July 27	Regalia	6	25	150	22	128	54	56
Do	do	Fashionables	3	50	150	3	147	40	206
Do	do	Londres finos	1	50	50	0	50	0	100
Do	August 12	Londres	5	100	500	300	200	0	43
Do	August 31	High life	6	50	300	28	262	51	35
Do	do	Media regalia	3	50	150	4	146	25	50

[a] Cigars of 1910 were all made from September 23 to November 15, boxed and kept in the general working room.

[b] Perfectos plain in box.

[c] Perfectos put up in tin foil but badly infested.

TABLE III.—*Injury to different grades of cigarettes.*[a]

Date examined.	Kind of cigarette.	Number of packages examined.	Total number of cigarettes.	Number good.	Number infested.	Insects found—	
						Alive.	Dead.
1911.							
June 30	El Pasig[b]	50	1,500	1,497	3	3	
June 30	Manila[b]	50	1,500	1,497	3	3	1
May 6	Sultanes[c]	1	100	41	59	2	58
June 2	Turkish[d]	100	2,400	1,487	913	72	7
June 5	do	11	264	67	197	0	18
June 29	do	100	2,400	903	1,497	235	28

[a] High-grade cigarettes with open ends, made about April 1 by machine.

[b] Value, 24 pesos per thousand.

[c] Value, 380 pesos per thousand.

[d] Value, 400 pesos per thousand.

The data for the above tables were obtained by carefully examining cigars taken from the general stock of various factories in Manila. The cigars were selected as near the same dates of making and boxing as possible.

From what has been said of oviposition, it will be seen that the larva, when full grown and ready to pupate, is usually inside the cigar or cigarette. It apparently makes little effort to get to the surface, but pupates wherever it happens to be, forming a flimsy cell (Plate I, fig. 5) of small particles of tobacco. When the larva is near the surface of the cigar, it eats a small round hole through the wrapper, and this is afterwards closed by the formation of the pupal cell, and the adult upon emerging only needs to break the flimsy cell to escape. In many cases the pupal cell is formed between cigars. Pupal cells vary in form in accordance with the place and conditions under which pupation occurs. Within cigars, the cells are usually ovoid. Where larvæ pupate against the sides of a cigar box or other substance, they simply form a dome over themselves. In leaf tobacco the pupal cells have no definite shape.

After the larva has confined itself within the pupal cell, it remains quiet for a period of from two to five days; it then shortens somewhat, molts, and the pupa results.

Pupa.—The pupa (Plate I, figs. 3 and 4) is of a whitish or cream color turning to brownish pink a short time before the emergence of the adult. The eyes are black and the mandibles brown. Upon emerging, the adult is very soft and pale brownish pink. It remains in the pupal cell about four days, during which time it hardens and the color changes to dark brown, after which it gnaws its way out. Laboratory experiments show that the minimum time spent in the pupal cell from the time it is formed by the larva until the adult emerges is eleven, the maximum fourteen, and the average 12.5 days.

Adult.—The adult beetles (Plate I, figs. 6 and 7) are small, brownish in color, and vary greatly in size; the latter is undoubtedly due to the quantity of food obtained by the larva. In every case it was observed that beetles obtained from the *high-grade, selected cigars* were about twice the size of those obtained from bales of lower grade tobacco. This shows plainly that the size of the adult is influenced by the quality of food eaten by the larva.

The adults are very lively and at almost any time can be found running about promiscuously upon the walls, windows, and furnitures of warehouses and tobacco factories. They fly freely in the early evening and during the night. They rest with head

and thorax drawn downward. (Plate I, fig. 7.) When disturbed, they drop, the head, thorax and legs are drawn close together, and they remain in this position for a few moments, feigning death. If not further molested, they soon crawl a short distance and then fly. As far as I have observed, the adults do not feed at all; therefore, there is no direct damage done by them. There was no noticeable damage done by the hundreds of beetles kept under observation in the laboratory for the egg-laying and other experiments. Table IV gives a record of an experiment in which 100 beetles were kept with 20 cigars:

TABLE IV.—*Results of keeping 100 beetles with 20 cigars.*[a]

Examinations.		
Date.	Adults dead.	Cigars injured.
Mar. 4	none	none
Mar. 11	26	none
Mar. 16	18	none
Mar. 19	53	none
Mar. 21	2	none
Mar. 22	1	none

[a] The open ends of the cigars had been closed previously by pasting tissue paper over them. This was to prevent the adults from entering the cigars at this point.

The beetles in this experiment had free access to the cigars and could at all times be seen running over them freely. Table V shows that no damage was done to leaf tobacco by the beetles.

TABLE V.—*Harmlessness of adults kept on leaf tobacco.*[a]

(Experiments started November 14. Five adults in each lot.)

Grade of tobacco used.	Amount fed.	Life of adults.		
		Minimum.	Maximum.	Average.
		Days.	*Days.*	*Days.*
Coarse filler	none	8	10	9
Fine filler	none	10	19	15
Wrapper, maduro	none	8	17	14
Wrapper, claro	none	10	15	14.5
Wrapper, Virginian	none	10	18	14.5

[a] This tobacco was carefully selected and the edges were trimmed with scissors so that the slightest amount of feeding could be detected. In all the experiments the adults laid eggs.

Copulation has been observed repeatedly in the laboratory and under natural conditions in the factories or warehouses, and takes place in from two to five days after the adults emerge.

The life of the beetle is determined more largely by the amount of energy stored at the time of emergence than by the external conditions, as is the case in many other insects. Table VI shows that the beetle in the adult stage consumes no food and that the average life is the same whether kept with or without tobacco.

TABLE VI.—*Length of life of adults.*

WITHOUT TOBACCO.

Date emerged.	Number of adults.	Died.		Lived.	Remarks.
		Date.	Number of adults.		
				Days.	
		September 28	2	8	Large larvæ were collected from cigars; pupated and emerged in the laboratory. Adults kept collectively copulated, and laid eggs.
		October 1 to 16	13	[a]16.4	
September 18 to 21	17				
		October 20	2	30	

KEPT WITH TOBACCO.

August 20	5	September 4 to 6	5	[a]16	Adults kept singly. Examined daily. These were bred from eggs, and reared in the laboratory.
September 29	1	October 14	1	15	
Do	1	October 20	1	21	
October 1	1	October 14	1	13	
Do	1	October 17	1	12	
October 6	1	October 20	1	14	
Do	2	October 24	2	18	
October 9	1	October 20	1	11	
Do	1	November 4	1	26	
October 24	1	do	1	10	

[a] Average.

Seasonal history.—This insect shows a continuous breeding period. Eggs, larvæ, pupæ, and adults can be found at any time of the year in tobacco warehouses and factories, but March and April seem to be the months of the greatest abundance of adults.

INSECTS MISTAKEN FOR THE CIGARETTE BEETLE

Many species of insects are found in dried tobacco in the Philippine Islands, and these are often mistaken for the cigarette beetle. Those most commonly mistaken are a species of Curculionidæ, the rice weevil (*Calandra oryzae* Linn.), a species of Bostrychidæ, the shot-hole bamboo borer (*Dinoderus brevis* Horn), and a species of Cleridæ. These insects are very abundant, especially the shot-hole borer. Its appearance in tobacco is easily accounted for. In the country all tobacco is cured in bamboo sheds, and as this beetle feeds upon and breeds in bamboo, its occurrence in tobacco is purely accidental.

The clerid is predaceous on the larvæ and pupæ of the cigarette beetle and, therefore, is to be considered as beneficial. It is not uncommon to find earwigs in tobacco bales; these are also mistaken for the cigarette beetle.

NATURAL CONTROL

There are many agencies concerned in the natural control of the cigarette beetle, the principal ones of which are the predatory enemies and parasites.

PREDATORY ENEMIES

So far, in the Philippines, but one species of insect has been found which preys upon the cigarette beetle. This is the Clerid mentioned above. (Plate I, figs. 10 to 13.) It can be found running freely through the bales of tobacco. It feeds ravenously, both in the larval and adult stages, upon the larvæ and pupæ of the cigarette beetle. Six adult Clerids devoured 31 larvæ of the cigarette beetle in a single night.

There is little doubt that birds, such as swallows and sparrows, which are very abundant in and around tobacco warehouses, especially in the country, play a part in natural control, but since no opportunity was afforded for a study of them it cannot be stated to what extent they are of value.

PARASITES

The parasites bred from the cigarette beetle belong to one species of Hymenoptera of the family Chalciiddæ (*Norbanus* [8] sp., Plate I, figs. 8 and 9.) This insect has been bred in the laboratory and has also been collected in the adult stage in infested

[8] Determined by Fullaway.

tobacco and cigars. It attacks the cigarette beetle only after the pupal cell is formed. By placing several of the parasites with cigarette beetle larvæ it was seen that the former, apparently frightened by the movements of the larvæ, did not attack them, but when pupæ were introduced they were attacked within a short time.

In one experiment pupæ of the cigarette beetle, in cells, were placed with the parasites. The latter immediately mounted the cells, and after traversing them several times began to pierce them with their ovipositors. Several attempts were made before the pupal cell could be pierced and, after locating the pupa, which was done by a sidewise motion of the body, oviposition into the pupa took place. The adult remained with the ovipositor in the cell from ten to fifteen minutes. Evidently a single egg only is laid in each pupa, as in no case did more than one parasite come from any of the pupæ. The life cycle of the parasite is from sixteen to seventeen days.

A very small white mite of the family Eupodidæ, genus *Rhagidia,* has also been found attacking the cigarette beetle in all stages except the adult, both in factories and the laboratory. Larvæ infested with mites have been placed in tobacco bales, and subsequent examinations, made at various intervals thereafter, failed to show that these parasites had been effectively established. It is doubtful if they will ever prove valuable as a parasite of the cigarette beetle.

ARTIFICIAL CONTROL

Many difficulties are encountered in the Philippine Islands in combating the cigarette beetle. Some of these are: that all tobacco in the provinces becomes infested at the time of curing, that the insects are packed in the bales of tobacco or gain access thereto after packing and the tobacco is stored from one to four years before being made into cigars, that the development of the insect is continuous throughout the year, that the infested stock is stored in close proximity to factories and in many cases in the factory itself, that the *mandalas* [9] are exposed and infested at all times, and that all stages of the insect are protected within the cigars or tobacco bales. The susceptibility of the tobacco to substances that would change its aroma,

[9] Mandalas are piles of tobacco in which fermentation is allowed to take place in the process of curing.

flavor, or burning quality must also be kept in mind, and only such substances used to kill the beetles as will not alter any of its original characteristics.

My first experiments were with repellents. Those that were repugnant to the beetles were also injurious to the cigars. Furthermore, traps for the adults were used with little better success. The solution of the problem is to place the factory in such a condition as to prevent the reinfestation of the treated stock and to obtain and use a substance that will kill the insects in all stages of development. By careful preparation of the factory and installation of proper apparatus, there will be no excuse for the shipment of infested stock from the Philippines and the consequent loss of trade caused by these damaged goods. Carbon bisulphide, hydrocyanic-acid gas, and high and low temperatures were experimented with and proved effective. The value of the first two as insecticides has long been recognized, but actual demonstration, as to use and dosage together with the care of the manufactured products after treatment, were deemed advisable.

It is popularly supposed, and frequently even by the manufacturers themselves, that the exposure of tobacco to great variations in temperature, to carbon bisulphide, and to hydrocyanic-acid gas may impair its quality and that by the use of the latter some of the cyanogens may be deposited in the cigars and make them injurious to the smoker. Experiments have been carried on to determine whether or not any one of the three essential characters of a good cigar—aroma, taste, and burning quality—is impaired by the two former treatments or whether any cyanogens are deposited in the cigars by the cyanide treatment. Qualitative and quantitative analyses of the tobacco and cigars were made for cyanogens, and by use of a special apparatus treated and untreated cigars were smoked and the smoke drawn through a solution of silver nitrate which was analyzed quantitatively for cyanogens. These experiments, which are described below, show that cyanogens in treated stock are not in excess of those in the untreated. Several treated and untreated cigars were also smoked by different habitual smokers, and the results show that the treated cigars are practically indistinguishable from the untreated.

At the factory of the Compañía General de Tabacos de Filipinas, a room (Plate III, fig. 1) was screened and freed from all insects by the use of hydrocyanic-acid gas and afterwards cigars

were made here from treated tobacco. The cigars were guarded in this room against reinfestation, and all experiments referred to as being made in a screened room were carried on here.

PREPARATION OF FACTORY

Before beginning the actual destruction of the cigarette beetle, it is necessary to place the factory in a condition to prevent the reinfestation of the treated stock. The first step is to free it from all stages of the beetle, which may be accomplished with hydrocyanic-acid gas in the manner hereafter described for the fumigation of tobacco.

In most cases in Manila, the drying, selecting, boxing, and labeling of cigars are carried on in one work room, and experiments have shown that these rooms may be absolutely protected after they are once freed from all stages of the beetle by covering the windows and doors with wire screens sufficiently fine (not coarser than 10 meshes to 1 centimeter) to prevent the passage of the adult beetles. Various sizes of mesh were tried and up to 8-mesh to the centimeter the beetles passed through readily. The 10-mesh was effective. The entrance to the compartment should have a screened vestibule with two screened doors (Plate III, fig. 1). As a further precaution against reinfestation, manufactured products should be kept in tin-lined boxes instead of being piled promiscuously on the floor, as is customary. The regular shipping boxes, which are tin-lined, can be used for this purpose if it is undesirable to have a special box. The cost of a tin-lined box large enough to hold 10,000 ordinary sized, boxed cigars is 7.50 pesos.

For the treatment of the tobacco the manufacturer may choose between fumigation and high or low temperature, but in either case only competent persons should be employed to do the work. In factories where steam drums are already installed, the latter would perhaps be preferable, but it would be advisable also to have a small compartment for fumigating the wrapper tobacco, for where the wrapper leaf is subjected to steam and an excess of moisture results from condensation, it becomes darker in color and less elastic. Cigars are classified in five grades in all factories, on the basis of color. They are supposed to be mild or strong according as the wrapper is light or dark, and are designated as follows: *claro, colorado claro, colorado, colorado maduro,* and *maduro.*

FUMIGATION

A compartment for fumigation (Plate III, fig. 2), 3.85 meters in length, 2.85 meters in width, 2.95 meters in height, containing 32.4 cubic meters, and suitable for 1,400 kilograms of leaf tobacco, can be constructed for less than 200 pesos. It should be lined with zinc, and have 3 shelves on each side, 1 meter wide and covered with poultry netting on which to lay the leaf tobacco. Where carbon bisulphide is to be used, the top shelf should be provided, at either end, with a small piece of board on which to set the dishes that contain the fumigant. The door should have 3 flanges padded with rubber packing, so that when it closes the compartment is absolutely tight. Such a compartment could be used either for the carbon bisulphide or the cyanide treatment.

The properties and characteristics of the chemicals used in fumigation should be thoroughly understood by the operator so that necessary precautions may be taken. Aside from this, fumigation is very simple. Tobacco should be treated in the leaf, and after being made into cigars should be placed immediately in the screened drying and selecting room. It is preferable to treat the leaf tobacco, as it is then loose and can be handled to better advantage. Furthermore, if cigars be allowed to stand after being made and fumigated before shipment, the beetles that were developing in them would be killed in the cigar and make the latter undesirable.

CARBON BISULPHIDE

Carbon bisulphide (CS_2) is a colorless, volatile liquid, having a specific gravity of 1.29 at 0°C., and is malodorous when mixed with air. It evaporates rapidly, and is extremely inflammable. As the vapor is heavier than air, carbon bisulphide must be placed at the top of the fumigating compartment. The gas is poisonous and should not be inhaled by the operator. Where one has a compartment especially prepared for fumigating, there need be no danger to the person doing the work.

Carbon bisulphide can be purchased in Germany or in the United States at a comparatively low figure. Its wholesale price delivered in Manila is 92 centavos per kilogram. Locally it retails for about 2.50 to 2.86 pesos per kilogram. It is put up in iron drums containing from 0.5 to 20 kilograms. Being

extremely inflammable, a spark of any description, even a lighted cigar or cigarette, may explode the fumes. Electric fans and lights should not be used inside the fumigating compartment, for there is danger of the production of sparks which will ignite the fumes.

The cigarette beetle in all its stages can readily be killed by carbon bisulphide of the concentration of 14.4 grams per cubic meter in air-tight vessels, where the fumes of carbon bisulphide come in direct contact with the insect. Where there is an abundance of tobacco in which the beetles are protected, a greater quantity of carbon bisulphide must be applied. Experiments prove that 32 grams of carbon bisulphide per cubic meter are very effective in the latter case, but in practical work it is recommended that slightly more (40 grams) be used in order to insure a satisfactory excess.

TABLE VII.—*Effect of different amounts of carbon bisulphide.*

Date.	Treatment.		Condition after fumigation.								Remarks.
	Quantity of CS_2 per cubic meter.	Length.	Eggs.		Larvæ.		Pupæ.		Adults.		
			Alive.	Dead.	Alive.	Dead.	Alive.	Dead.	Alive.	Dead.	
1911.	*Grams.*	*Hours.*									
June 23	32	36	-----	------	0	116	0	13	0	68	Tobacco fumigated in manos.
June 26	32	48	-----	------	0	17	0	0	0	18	
Aug. 2	14.5	16	20	0	0	12	0	6	0	20	Eggs were fumigated only 6 hours.
Sept. 13	24	24	2	337	33	167	0	10	0	50	Larvæ lived and some developed into adults, but did not feed after fumigation.
Sept. 20	34	17	0	80	0	125	0	50	0	75	

Table VII shows that the adults and pupæ are more susceptible to the gas than are the eggs and larvæ. The fumigations dated September 13 and 20, except in the amount applied and the duration of the experiment, were done under identical conditions. All pupæ and adults in both were killed. In the experiments of September 13 the larvæ appeared to be dead, but on the second day some revived; they did not feed; 18 pupated and 11 emerged, 5 lived until November 16 and then died; the adults laid no eggs.

Leaf tobacco, fumigated at the rate of 32 grams per cubic meter, was made into cigars on different dates, care was taken to prevent reinfestation, and cigars were examined at intervals. The following table gives results of these experiments:

TABLE VIII.—*The condition of cigars fumigated with carbon bisulphide (32 grams per cubic meter), made and kept under different conditions.*

Cigars and cigarettes.		Date made.	Date boxed.	Length of treatment.	Date examined.	Remarks.
Kind.	Number.					
				Hours.		
Londres	100	May 29	June 1	48	Aug. 24 Nov. 8 Jan. 8	Cigars fumigated in general compartment, made and guarded in screened room.
Pereire	100	June 28	June 30	24	July 13 Aug. 9 Sept. 8 Oct. 12 Nov. 10	Cigars made and kept in screened room. Cigars were in good condition at all examinations.
Conchas especiales	100	----do----	----do----	24		
Vegueros finos	100	----do----	----do----	24		
Londres	100	----do----	----do----	24		
Turkish cigarettes	200	June 30	June 30	24	July 13 Aug. 9 Sept. 8 Oct. 12 Nov. 10	Do.
Perfectos	50	July 1	July 2	24	July 13 Aug. 9 Sept. 8 Oct. 12 Nov 10	Tobacco taken from a lot of 1,400 kilograms that had been fumigated in large compartment; in good condition at last examination. Cigars made and kept in screened room.
Conchas especiales	50	----do----	----do----	24		
Vegueros finos	50	----do----	----do----	24		
Londres	50	----do----	----do----	24		
Perfectos	100	July 25	July 26	36	July 13 Aug. 9 Sept. 8 Oct. 12	Tobacco (fumigated) made in general work room, but kept in screened room. All remained uninfested.
Media regalia	100	----do----	----do----			
High life	100	----do----	----do----			
Panatelas	100	----do----	----do----			
Conchas especiales	50	Sept. 7	Sept. 7	18	Oct. 12 Nov. 10 Jan. 8	Cigars made in general room; kept in screened room. All remained uninfested.
Londres	50	----do----	----do----			

A check, in which samples taken from different lots of treated tobacco were made into cigars and subjected to factory conditions, was carried on simultaneously with these experiments, and in all cases, as shown in Table XVII, the cigars became reinfested.

The cost of fumigating 1,400 kilograms of leaf tobacco is about 15 centavos per 1,000 cigars, when the carbon bisulphide is purchased at the local price and is used at the rate of 1.25 kilograms to 32 cubic meters or 39 grams per cubic meter.

DIRECTIONS FOR USING CARBON BISULPHIDE

Fumigation is a simple process when the cubic contents of the fumigating compartment are known. Place the desired amount of leaf tobacco on the shelves, and for each cubic meter use at least 32 grams of the fumigant. Pour the liquid into shallow dishes, place the latter on the top shelf of the fumigating compartment, and close the door. After submitting the tobacco to the fumes of this gas for a period of at least twenty-four hours, the door may be opened and a current of air directed into the compartment in order to drive out residue fumes, before any person is allowed to enter. In all cases the fumigating compartment should contain its full capacity of tobacco, as the amount of carbon bisulphide used would necessarily have to be the same whether the compartment were full or only partly so. Treated tobacco should be taken directly to the working room in quantities large enough for only one-half day's work, and after the cigars are made they should be placed immediately in a screened drying and selecting room.

When not in use, the fumigating compartment should be kept closed to prevent reinfestation, and tobacco taken out should be returned to the compartment only for refumigation.

Precautions to be observed in the use of carbon bisulphide are as follows:

1. Carbon bisulphide is extremely explosive, and no sparks should come in contact with the fumes.
2. The gas is poisonous, and should not be inhaled.
3. Carbon bisulphide should be stored in a cool, dark place in glass-stoppered bottles or original drums.

HYDROCYANIC-ACID GAS

In order to generate a maximum [10] amount of hydrocyanic-acid gas, potassium cyanide, 98 per cent pure, commercial sulphuric acid, 93 per cent pure, and water should be mixed in the following proportions.

Potassium cyanide, 98 per cent	30 grams.
Sulphuric acid, commercial, 93 per cent	30 c. c.
Water	60 c. c.

These amounts will give the required quantity of hydrocyanic-acid gas for each cubic meter of the fumigation compartment.

[10] *Bull. U. S. Dept. Agr., Bur. Ent.* (1911), 90, Pt. 1.

If it is desired to insure complete fumigation of a compartment of the dimensions described under "Fumigation" containing 32.4 cubic meters, then the following quantities should be used:

Potassium cyanide, 98 per cent	1 kilogram.
Sulphuric acid, commercial, 93 per cent	1 liter.
Water	2 liters.

If a greater proportion of water is used than described, the yield of gas is decreased by about 4 per cent for each additional liter until 7 liters of water are used, when the yield of gas begins to drop off even more rapidly as shown by Table IX:

TABLE IX.—*Percentage of available hydrocyanic-acid gas given off when different quantities of water are used.*

Relative proportion by weight of—			Proportion of available gas given off.
Potassium cyanide.	Acid.	Water.	
			Per cent.
1	1	1	87.84
1	1	2	93.75
1	1	3	89.95
1	1	4	86.25
1	1	5	81.68
1	1	6	79.65
1	1	7	73.47
1	1	8	43.27

Potassium cyanide can be obtained at any drug store or purchased in large quantities in Germany and in the United States; 98 per cent pure sells for 1.29 pesos per kilogram, delivered in Manila.

DIRECTIONS FOR FUMIGATING WITH HYDROCYANIC-ACID GAS

The compartment should always be filled to its full capacity with tobacco when fumigating. Hydrocyanic-acid gas is lighter than air and should be liberated at the bottom of the compartment. Earthenware jars should always be used for generators; sulphuric acid attacks metal, and glass is too fragile. When all is ready, mix the water and sulphuric acid in the generator, always by pouring the acid into the water; then, while the solution is still hot, add the cyanide. Better results are obtained with a hot solution. Never reverse the order of mixing. When

more than one generation is used for a given space, care must be taken to have the chemicals proportionately distributed between the generators. Under no circumstances should a person be in the compartment when evolution of this gas commences. The cyanide should be added to the sulphuric acid and water from the outside. This can be done easily by placing the cyanide in a paper bag and lowering it into each generator by means of strings which pass through screw eyes at the top of the compartment. Each string should be arranged so that one end hangs directly over the generating vessel and the other passes out through a small hole at the side of the door. After lowering the cyanide into the generator, the hole through which the strings pass must be closed to prevent the escape of the gas.

After exposing the tobacco to the fumes of this gas for a period of at least twenty-four hours, the compartment may be opened. The operator should hold his breath while opening the door, and should retreat immediately out of reach of the fumes. About fifteen minutes are sufficient to allow the fumes to pass away, provided a current of air can be directed into the compartment, otherwise a half-hour is not too long to wait before entering.

A poisonous bluish residue will be left in the generators and should be disposed of immediately by pouring it into holes in the ground and covering with earth or emptying it into the sewer trap and flushing for some time.

PRECAUTIONS

Hydrocyanic-acid gas is a most deadly poison, and there is no antidote. Do not inhale any of it. The potassium cyanide and sulphuric acid used for the production of hydrocyanic-acid gas are both poisonous and must be handled with due precaution. If the following points are carefully observed, there need be no danger from the use of these substances.

1. Always keep the sulphuric acid in glass-stoppered bottles, and take care not to get the acid on the skin or on the clothing, as it produces serious burns.

2. Potassium cyanide should never be handled with the bare hands, as small pieces might get under the finger nails, be transferred to the mouth, and produce cyanide poisoning. Gloves or wooden pincers are convenient for working with cyanide. Potassium cyanide should be kept in tightly covered vessels as otherwise it deteriorates rapidly.

3. Never reverse the order of mixing the chemicals. Always pour the

water in the generators first, then add the acid, and after closing the compartment lower the cyanide into the mixture.

4. Never enter the compartment after the evolution of the gas has begun.

5. In opening the compartment after fumigation, hold the breath and make a hasty retreat. At least fifteen minutes should elapse before returning to the vault.

Sulphuric acid may be purchased from the same sources as potassium cyanide. That of 1.84 specific gravity may be bought at 0.77 peso per kilogram, wholesale in Manila. At the above prices the cost of fumigating 1,400 kilograms of leaf tobacco would be 2.06 pesos.

In the experiments with the cyanide treatment, tobacco treated with the gas liberated from 32 grams of potassium cyanide per cubic meter of compartment made into cigars and kept under different conditions showed the following results:

TABLE X.—*Condition of cigars fumigated with hydrocyanic-acid gas (32 grams of potassium cyanide per cubic meter), when kept under different conditions.*

Kind of cigar.	Number of cigars.	Date made.	Date boxed.	Length of treatment.	Date examined.	Remarks.
				Hours.		
Perfectos	200	July 25	July 25	36	July 21	Cigars made in general room; guarded in screened room; boxed immediately; all good at each examination.
High life	200	ditto	ditto	36	July 28	
Media regalia	200	ditto	ditto	36	Nov. 8	
Panatelas	200	ditto	ditto	36	Jan. 8	
Conchas especiales	50	Aug. 24	Aug. 30	24	Sept. 27	Cigars fumigated after being made; kept in screened box in general drying room; cigars good at each examination.
Princesas	50	ditto	ditto	24	Nov. 8	
Londres	50	ditto	ditto	24	Jan. 8	
Boquets	50	ditto	ditto	24	Jan. 12	
Panatelas	200	Sept. 20	Sept. 27	36	Sept. 27	Filler was steamed and wrapper treated with cyanide. Made in general room; kept in screened box in dry room; cigars good at each examination.
Republicanos	200	ditto	ditto	36	Nov. 8	
Media regalia	200	ditto	ditto	36	Jan. 8	

In the laboratory experiments, 30 grams of potassium cyanide were found effective for all stages of the cigarette beetle, as is shown by Table XI. Where eggs were not removed from the leaf on which they were laid, 28 grams per cubic meter for twenty-four hours killed about 95 per cent of them.

TABLE XI.—*Effect of different amounts of hydrocyanic-acid gas.*

Date.	Treatment.		Stages of insects.								Remarks.
	Quantity of KCN per cubic meter.	Length.	Eggs.		Larvæ.		Pupæ.		Adults.		
			Dead.	Alive.	Dead.	Alive.	Dead.	Alive.	Dead.	Alive.	
	Grams.	*Hours.*									
July 29	35	22	20	0	------	------	------	------	------	------	Eggs removed from leaf.
August 2	28	24	29	1	------	------	------	------	------	------	
August 3	32	13	20	0	------	------	------	------	------	------	Eggs fumigated in leaf tobacco.
August 6	30	24	200	0	------	------	------	------	------	------	
September 14	10	18	49	3	106	94	4	27	46	16	Eggs fumigated where adults had laid them; they were well covered with other tobacco.
September 16	30	24	306	0	------	------	------	------	------	------	
November 29	10	40	------	------	------	------	------	------	66	4	

In a recent circular of the Bureau of Agriculture of the Philippines,[11] a dose of 9 grams of potassium cyanide per cubic meter was recommended as sufficient for killing this insect. In former experiments I had found that 28 grams per cubic meter were insufficient for killing the eggs, but for further confirmation I carried on several experiments with the amount recommended with the results shown in Table XII.

TABLE XII.—*Showing effect of hydrocyanic-acid gas liberated from 9 grams potassium cyanide per cubic meter.*

Date.	Length of treatment.	Stage of insect.				Remarks.
		Eggs.		Adults.		
		Alive.	Dead.	Alive.	Dead.	
	Hours.					
November 14	24	-------	-------	13	67	Adults in tobacco.
November 18	48	-------	-------	0	105	Adults exposed directly to fumes.
November 20	12	-------	-------	0	25	
November 21	36	-------	-------	0	50	
November 23	24	10	10	-------	-------	Eggs on tobacco leaf where they had been laid.
November 24	24	-------	-------	280	332	Adults allowed to get into manos of tobacco.
November 25	96	-------	-------	212	182	Adults, fumigated in manos of tobacco.
November 25	24	30	20	16	234	Fumigated with tobacco.

In no case, where tobacco was present, was the treatment with 9 grams of potassium cyanide per cubic meter effective, but in a glass jar, where adults were confined in a very small space and exposed directly to the fumes, it was effective. The

[11] The Cigarette Beetle. Cir. P. I. Bur. Agr. (1912), 5.

potassium cyanide with which these experiments were made was analyzed and found to be 98 per cent pure.

On November 24, 550 larvæ of *Lasioderma serricorne* were fumigated in tobacco waste for twenty-four hours with the gas liberated from 9 grams of potassium cyanide per cubic meter of compartment, and 171 were killed while 379 lived and developed into adults.

TEMPERATURES

Where it is not desirable to use chemical treatment for the control of the cigarette beetle, or in cases where machinery already is installed for steaming tobacco, the manufacturer can resort to steam as a weapon against this pest. The method of storing after treatment described under "Preparation of Factory" would always guarantee the stock.

In spite of the prejudice against steaming tobacco, experiments in smoking cigars made of steamed tobacco show that the treated cigars, although smoked by habitual smokers, are indistinguishable from the untreated. The only apparent damage done to the steamed tobacco is that suffered by the finest wrapper. As before stated, steaming the wrapper has a tendency to give it a darker color and the leaf becomes somewhat brittle. However, this can be avoided where the proper drum (Plate IV, fig. 1) is used and wrapper tobacco is placed in the center of the drum with filler tobacco all around it. Experiments have shown that in the treatment of the finest wrapper leaf about 5 per cent of the wrapper that would make *claro* or *colorado claro* cigars must be put into the *colorado, colorado maduro,* and *maduro* grades. While this causes absolutely no loss of tobacco, the manufacturers deem it a loss because of the preference in the market for the milder or lighter grades of cigars.

I had the opportunity of using a steaming drum especially prepared for tobacco with a view to the control of the cigarette beetle during the period of this investigation (Plate IV, fig. 1). This apparatus consists of a cylindrical drum within which is a track upon which runs a perforated car large enough to hold about 120 kilograms of leaf tobacco. After the leaf tobacco is placed in the car, it is pushed into the drum, and the door is clamped down tight upon rubber gaskets. The steam can be introduced at any pressure up to 8 atmospheres. The temperature in the drum varies from 96° to 102°, depending upon the pressure of the steam from the boiler. Another steam drum (Plate IV, fig. 2), which can be used but which is not as convenient as the one just described, can be obtained from London

for 1,300 pesos; or a common wooden compartment can be built in which the effective temperature could be secured. This latter could be erected at a cost not to exceed 100 pesos. The drum illustrated by fig. 1, Plate IV, is preferable, as in the two last mentioned, the tobacco must be removed by hand, and since there is no carriage the tobacco comes in direct contact with the sides of the drum or compartment and there is greater danger of getting it too wet by condensation.

After the tobacco has been subjected to the steam for twenty minutes at about 4 atmospheres, the exhaust is opened on the outside of the building. The door is then opened, the car pulled out on the track, and the tobacco shaken out. After steaming, at least one day is required to dry the tobacco before it can be made into cigars, and a small screened apartment for this purpose is necessary. After completion, the cigars should be guarded against reinfestation as in the cases of fumigation.

After steaming leaf tobacco in the drum for a period of twenty minutes at the above temperature, all insects found were dead. Experiments were tried with the cigarette beetle in all its stages, submitting them to temperatures from 60° to 90° C., for periods from ten to twenty minutes, and in each test all the insects were killed. The minimum effective temperature was not determined. However, this is not necessary as the temperature in drums while subjected to steam never falls below the killing temperature. Tobacco steamed as described above, placed in a screened room to dry, then made into cigars and kept under conditions to prevent reinfestation, proved good at the end of eight months.

Table XIII gives the results of the various temperature experiments.

TABLE XIII.—*Effects of different temperatures on different stages of the cigarette beetle.*

Temperature.	Time subjected.	Stage of insects.				Remarks.
		Eggs.	Larvæ.	Pupæ.	Adults.	
°C.	*Minutes.*					
90	20	20	----------	----------	20	All the adults were dead when removed. The larvæ, pupæ, and eggs were kept in dishes to determine if dead or not. All larvæ and pupæ turned black after two days. Eggs were kept two weeks and examined under the microscope. All were dried; none hatched.
85	10 to 35	60	70	15	20	
80	20	20	----------	----------	----------	
75	10 to 35	60	50	----------	----------	
70	20	40	----------	----------	----------	
65	20	20	----------	----------	----------	
60	20	20	20	20	20	Check eggs in these experiments all hatched.

These experiments were conducted with a moist heat such as would be found in the steam drum. The experiments of 75° and 80° were conducted at exposures from ten to thirty-five minutes. Cigars were partly hollowed out, the insects in different stages put inside the holes, and the cigars wrapped again with tobacco leaf and subjected to heat. A temperature as low as 60°C. for twenty minutes killed the cigarette beetle in all stages.

Table XIV gives the results of experiments with steamed tobacco made into cigars.

TABLE XIV.—*Results of experiments with cigars made from steamed tobacco and guarded against reinfestation.*

Kind of cigar.	Number of cigars.	Date made.	Treatment.		Date boxed.	Date examined.	Remarks.
			Temperature.	Duration.			
			°C.	*Mins.*			
Perfectos	100	June 24	96	20	June 30	July 13 Aug. 9 Sept. 8 Oct. 12 Nov. 10 Jan. 8	Cigars made and kept in a screened room; good at each examination.
Conchas	100						
Vegueros finos	100						
Londres	100						
Perfectos	100	June 27	102	25	June 30	July 13 Aug. 9 Sept. 8 Oct. 12 Nov. 10 Jan. 8	Do.
Conchas	100						
Vegueros finos	100						
Londres	100						
Panatelas	100	July 12	120	15	July 21	Sept. 27 Nov. 8 Jan. 8	Cigars made in general room and kept in screened room; good at each examination.
Perfectos	100						
Media regalia	100						
High life	100						
Panatelas	50	July 12	100	20	July 21	Sept. 27 Nov. 8 Jan. 8	Cigars made in general room and kept in tight tin boxes; good at each examination.
Perfectos	50						
Media regalia	50						
High life	50						

Cost of steaming.—As nearly all cigar and cigarette factories in Manila are at present equipped with machinery and boilers, the only cost to those who wish to use this method is that of the drum and its installation. Since the steaming process is of short duration, it would be difficult to calculate the actual cost of treating the tobacco where machinery is already installed.

In the application of steam, the principal requisite is that the wrapper tobacco should not become too wet.

Where cold storage is available, the cigars can be stored for a time with good results, provided a sufficiently low temperature

can be obtained. Proper receptacles for the cigars, together with as dry an atmosphere as possible, are necessary. Care must be taken to avoid mold which appears within a very short time on damp cigars. A zinc-lined box with rubber packing for the lid was found most satisfactory in the cold storage experiments. Cigars packed in wooden boxes contracted moisture and became more or less wet when taken out of cold storage.

It would undoubtedly be out of the question to install, in the various factories, cold storage plants of sufficient capacity and efficiency to give the proper degree of temperature for killing the cigarette beetle, but in places, such as Manila, where such a plant already exists, good results can be obtained by subjecting the manufactured product to cold for a given period of time. In the experiments to test the efficiency of cold storage, no attempt was made to determine the exact degree at which the insect is killed, and only those temperatures available at the Insular cold storage plant were used.

Four thousand Londres and 4,000 Coronitas cigars, packed in a tin-lined box, were placed in cold storage for eight weeks. Upon removal they had not molded, and were in good condition, while 1,000 other cigars placed in wooden boxes had absorbed moisture to such an extent that they had to be dried out again.

The following table is a summary of the results of cold storage upon the beetle in its different stages at the lowest temperatures available at the Insular cold storage plant.

TABLE XV.—*Effect of cold storage at 7°.8 C. upon the cigarette beetle in its different stages.*

Stage of insect.	Length of exposure.	Number of individuals exposed.	Number killed.	Remarks.
	Days.			
Eggs	1½	6	4	Two hatched, slightly retarded.
Do	2	5	5	
Do	3	58	58	Daily observations were kept on these. None hatched. Eggs were left in cold storage from 1.5 to 25 days. Check on these eggs (50) all hatched.
Do	4	14	14	
Do	5 to 25	1,271	1,271	
Larvæ	4	66	66	
Do	5	40	40	Larvæ whitish, but turned black soon after removal.
Do	7	187	187	
Pupæ	7	86	86	Pupæ all dead.
Adults	3	150	150	Some laid a few eggs in cold storage. None hatched.
Do	5	50	50	Some laid eggs in cold storage; none hatched.

It is plainly seen that at a temperature of −7°.8 the beetle in all stages can be killed in four days.

A similar experiment was carried on at the Bureau of Science where the temperature varied from 8° to 14°C. This did not kill the insect in any stage but only prolonged the period of development. Larvæ (full grown, at least 40 days old) lived one hundred fifty-seven days, but did not feed. Eggs were retarded in hatching; pupæ developed to adults, and these lived one hundred eleven days after emerging. The detailed data are given in Table XVI.

TABLE XVI.—*Effect of cold storage on the cigarette beetle in different stages, at temperatures varying from 8° to 14° C.*

Stage of insect.	Number.	Remarks.
Eggs	20	Taken out after 20 days; 14 hatched; 6 destroyed by mites.
Do	20	Taken out after 22 days; 3 hatched; 13 destroyed by mites.
Small larvæ	7	The longest life was 30 days.
Half-grown larvæ	30	Do.
Full-grown larvæ	30	The longest life was 157 days.
Pupæ	10	All developed and emerged; the last after a period of 30 days.
Adults	10	Emerged in cold storage, and lived 111 days.

Cost of cold storage.—At the division of cold storage of the Bureau of Supply, cigars would be stored according to the following schedule of charges:

TABLE XVII.—*Schedule of charges for storage space at the division of cold storage, Bureau of Supply.*

Space occupied.	Charge per cubic meter.	
	Per day.	Per 30 days.
	Pesos.	*Pesos.*
Less than 1 cubic meter	0.25	7.50
1 to 50 cubic meters	0.21	6.30
50 to 500 cubic meters	0.17	5.10
500 to 1,000 cubic meters	0.14	4.20
Over 1,000 cubic meters	0.11	3.30

From 10,000 to 12,500 boxed cigars occupy 1 cubic meter. At the above rate one could effectively treat cigars at 10 centavos per thousand by using 1 cubic meter of space for a period of four days. The ordinary tin-lined shipping box would be very

convenient. Cigars packed in this way should be subjected to cold for a period of at least six days. Large packages should be avoided as it takes longest for the cold to affect them.

MISCELLANEOUS EXPERIMENTS

A check, in which samples taken from different lots of treated tobacco were made into cigars and subjected to factory conditions, was carried on simultaneously with the foregoing experiments. The results have been indicated in Table XVIII.

TABLE XVIII.—*Results of experiments with treated stock where cigars were subjected to general factory conditions.*[a]

Kind of cigar.	Number of cigars.	Date made.	Treatment.		Date examined.
			Method.	Length.	
				Hrs. mins.	
Vegueros finos	50	July 1	Steam	0 20	August 27 and November 10.
Conchas especiales	50	do	do	0 20	
Do	50	do	do	0 25	Do.
Pereire	50	do	do	0 25	
Vegueros finos	50	do	do	48 00	Do.
Conchas especiales	50	do	30 grams CS_2 per cu. meter.	48 00	
Perfectos	50	do	32 grams KCN per cu. meter.	30 00	Do.
High life	200	June 1	38 grams CS_2 per cu. meter.	48 00	Do.
Perfectos	50	Sept. 7	Cigars untreated; general factory run.		October 12 and December 10.

[a] All of these cigars were made, dried, boxed, and kept in the factories with general stock. They became infested before the first examination. At the subsequent examination, only a few cigars were uninfested.

From the above it is plain that, although the tobacco was treated and all stages of the insect killed, as shown in Tables IX, XII, and XV, the treated cigars became infested as did the untreated. It is seen that infestation of manufactured tobacco can and does occur in the drying cabinets (Plates V, figs. 1 and 2) and selecting room, hence the importance of having these free from all stages of the cigarette beetle. Infestation may also occur after boxing, as many of the ordinary cigar boxes are defective. These facts demonstrate that the cigars must be kept under conditions which will prevent reinfestation. An open mandala where beetles have free access for oviposition is shown in Plate VI, fig. 1. The infestation of mandalas can be controlled to a certain extent by the use of a modern fermenting compartment (Plate VI, fig. 2). This can be so arranged as to prevent

the beetles from entering freely and it will give just as satisfactory results as the open mandala.

Tobacco stored in warehouses (Plate VII, fig. 1) and in general work rooms (Plate VII, fig. 2) furnishes a fresh supply of beetles at all times. Bales of infested tobacco should not be stored in the factory itself.

TRAPS

During the period of my study of the cigarette beetle, the manager of the Germinal cigar factory carried on light-trap experiments, placing a basin of petroleum under an electric light. This produced results far from satisfactory, no more than 5 to 8 beetles being caught in a single night, although the factory was badly infested at all times. I have found the most effective trap to be leaf tobacco itself. Several manos of leaf tobacco (Plate VIII, fig. 1) were placed in various parts of a warehouse. After a period of from twelve to twenty hours these were examined and the number of trapped beetles recorded.

TABLE XIX.—*Effectiveness of leaf tobacco as a trap for the cigarette beetle.*

Number of manos.	Length of time exposed.	Where exposed.	Number of adults.	Condition of manos.
	Hours.			
5	12	On bales of tobacco	155	Open.
5	12	-----do	255	Closed.
10	16	In window	28	Do.
10	12	On bales of tobacco	272	Open.
10	12	-----do	310	Closed.
10	20	-----do	461	Do.
5	18	In window	32	Do.
10	18	On bales of tobacco	557	Open.
15	18	-----do	640	Closed.
20	20	-----do	1,006	Do.

From Table XIX it will be seen that a great number of the adults may be trapped by this method. By carefully placing the trap manos in a fumigating box and by using one of the fumigants already suggested, the trapped beetles can be readily destroyed. Tobacco in manos can be used to good advantage as a trap in the general work room if, after working hours, all other tobacco be removed and these manos placed in various parts of the room. Before work is begun the following day, the manos should be collected and fumigated or the beetles shaken out into a pan of water and petroleum. Care must be exercised when collecting them not to jar the beetles from the tobacco.

SMOKING EXPERIMENTS

In view of the fact that there was thought to be a possibility of the deposition of cyanogen in the cigars by the cyanide treatment, several experiments were carried on to determine this point.

Cigars and leaf tobacco were treated with the requisite minimum of cyanide, 32 grams per cubic meter, and after treatment, analyses by chemists of the Bureau of Science showed the presence of hydrocyanic-acid gas in both the treated and untreated tobacco, but the amount was so small that in samples of less than 400 grams no quantitative determination could be made. The hydrocyanic-acid gas in 50 grams of treated tobacco was administered to a guinea pig without ill effects.

A series of treated and untreated cigars was smoked by means of an aparatus (Plate VIII, fig. 2), and the volatile products of combustion passed through a solution of silver nitrate, which was to fix the cyanogens which would ordinarily be taken in by the smoker, and afterward analyzed quantitively. Cigars of various brands were fumigated with cyanide and smoked simultaneously with a corresponding number of untreated cigars of the same brand. Hydrocyanic-acid gas was obtained in each case, and not infrequently the untreated cigars gave more of this product than did the treated. Any differences which really exist between the yield of hydrocyanic-acid gas from the treated and untreated cigars are so small in comparison with the total yield that they are negligible as shown by Table XX, which gives the actual amount of the tobacco smoked and of cyanides found.

TABLE XX.—*Hydrocyanic-acid gas (HCN) in treated and untreated cigars.*[a]

Number of cigars.	Cyanide treatment.		Tobacco actually smoked.	HCN gas found.	HCN per gram of tobacco smoked.	Average HCN per gram of tobacco smoked.	Remarks.
	Potassium cyanide per cubic meter.	Duration.					
	Grams.	*Hours.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	
12	32	24	78.40	0.0648	0.000826	0.00106	Cigars aërated 5 days before smoking.
12	32	24	81.17	0.1049	0.00129	----------	Cigars aërated 10 days before smoking.
12	none	none	74.2	0.0849	0.00114	0.00114	Cigars not treated and used as a check.

[a] Analyses by F. B. Beyer, division of general, inorganic, and physical chemistry, Bureau of Science.

Table XX shows that for each gram of treated tobacco actually smoked there was obtained from the products of combustion 0.00106 gram of hydrocyanic-acid gas, while in the untreated, for each gram of tobacco smoked, 0.00114 gram of hydrocyanic-acid gas was obtained, a difference of 0.00008 gram. This indicates that hydrocyanic-acid gas fumigation does not increase the normal cyanogen content of smoking tobacco.

In the combustion of any cigar a quantity of hydrocyanic-acid gas is produced. This quantity depends on a number of variable factors, such as the moisture, rate of combustion, firmness of the cigar, etc. This amount far exceeds that which it is possible for a cigar to absorb during fumigation. Since the simplest compounds are usually first to be destroyed by heat in the presence of air, it is more than probable that any hydrocyanic-acid gas retained from the fumigations is immediately converted into carbon dioxide, water, and nitrogen according to the following reaction:

$$4\ HCN + 5O_2 \rightarrow 4CO_2 + 2H_2O + 2N_2.$$

Furthermore, experiments confirm this fact and show that the hydrocyanic-acid gas actually obtained from treated cigars is, on the average, less than that from untreated cigars when smoked under identical conditions. Sixteen treated cigars were also placed in the smoking apparatus in sets of four, and air was drawn through each set for twenty minutes, and passed through a solution of silver nitrate. This solution was afterward analyzed for hydrocyanic-acid gas. The results were negative, thus showing that there exists in fumigated cigars no free hydrocyanic-acid gas.

In smoking treated and untreated cigars with the apparatus, particular attention was given to the requisites which are of importance in judging the burning qualities; these are, the uniformity of combustion, the capacity for retaining a light, and the color and firmness of the ash. In no case could any distinction be made between the treated and untreated cigars. Both held the fire well, and the ash was of the proper color and in most cases retained the shape of the cigar from the time of lighting until it was completely smoked. The burning quality is apparently not affected by treatment.

In judging the merits of the different cigars after the various treatments it was requested of those who smoked them that they note aroma, taste, and burning quality. Various lots of cigars of a given number were distributed to habitual smokers

more or less familiar with the brands which they were to smoke. Each lot contained an equal number of treated and untreated cigars, and each cigar was numbered. A card with numbers corresponding to those on the cigars accompanied each lot with the request that the smoker use two cigars of the same brand in succession, and give his opinion as to aroma, taste, and burning quality with such additional remarks on the various cigars as he saw fit. The smokers did not know which cigars were treated and which untreated and in no case were the cigars distinguished. Tables XXI to XXVIII give the results obtained from tests by 30 habitual smokers.

TABLE XXI.—*Twenty-five Perfectos treated with carbon bisulphide and 25 untreated Perfectos were used in this test.*

No. of cigar.	Treated.			Untreated.			Cigar preferred.	Remarks.
	Aroma.	Taste.	Burning quality.	Aroma.	Taste.	Burning quality.		
1	Good	Regular	Good	Good	Regular	Good	No choice	
2	do	Good	do	Bad	Bad	Bad	Treated	Could not smoke untreated.
3	do	do	do	Good	Good	Excellent	Untreated	Treated cigar good, but not better than average cigar.
4	do	Strong	do	do	do	Good	do	
5	do	Aftertaste	do	do	Strong	Even	do	Slight difference in treated and untreated.
6	do	Inferior	Even	Fair	Fair	do	do	
7	do	Good	Good	Good	Good	Good	No choice	
8	do	Strong	do	Bad	Bad	Bad	Treated	Treated cigar had taste of green tobacco.
9	do	Good	do	Good	Good	Good	No choice	
10	Superior	do	Fair	Excellent	Excellent	Excellent	Untreated	
11	Regular	Strong	Poor	Good	Mild	do	do	
12	Good	Good	Good	do	Strong	Good	Treated	
13	do	Slightly impaired	do	Fair	Fair	do	Untreated	Treated cigar had taste of green tobacco.
14	do	Fair	do	do	Strong	do	Treated	Preferred treated.
15	do	Good	do	do	do	Fair	do	Do.
16	do	do	do	Good	Good	Good	No choice	
17	do	Fair	do	Fair	Bad	Bad	Treated	
18	do	Good	do	Good	Good	do	No choice	Untreated had taste of green tobacco.
19	Fair	do	do	do	do	do	Treated	
20	Good	do	do	Bad	Bitter	do	do	
21	Fair	Fair	Fair	Excellent	Excellent	Excellent	Untreated	
22	Excellent	Excellent	Excellent	do	do	do	No choice	
23	Good	Good	Good	Good	Good	Good	do	
24	Fair	Fair	Fair	Fair	Fair	Fair	Treated	Preferred treated.
25	Good	Good	Good	Bad	Bad	Bad	do	

TABLE XXII.—*Twenty-five Bouquets made from steamed tobacco and 25 untreated Bouquets were used in this test.*

No. of cigar.	Treated.			Untreated.			Cigar preferred.	Remarks.
	Aroma.	Taste.	Burning quality.	Aroma.	Taste.	Burning quality.		
1	Good	Good	Good	Good	Good	Good	No choice	
2	do	Agreeable	do	do	Mild	do	do	
3	do	Good	do	do	Good	do	do	
4	Fair	Fair	Fair	Fair	Fair	Fair	do	
5	Excellent	Excellent	Good	Good	Good	Good	Treated	
6	Good	Good	do	do	do	do	No choice	
7	Fair	Fair	Fair	Fair	Fair	Fair	Untreated	Did not care for either.
8	do	do	do	do	do	do	No choice	Do.
9	Good	Strong	Good	Good	Good	Bad	Treated	
10	do	Good	do	do	do	Good	No choice	
11	do	do	do	do	Strong	do	Treated	
12	Fair	Fair	Fair	Fair	Fair	Fair	do	Preferred treated cigar.
13	Good	Biting	Good	Good	Good	Good	Untreated	
14	Fair	Good	do	do	do	do	do	
15	Poor	Poor	do	Fair	Fair	do	do	
16	Good	Good	Poor	Good	Good	Poor	No choice	Slight difference; favors untreated.
17	Natural	Normal	Good	Natural	Normal	Good	do	
18	Fair	Fair	Fair	Fair	Fair	Fair	do	
19	Superior	Good	Good	Good	Good	Good	Treated	
20	Good	Fine	do	Bad	Fair	Bad	do	
21	Poor	Bad	Poor	Fair	Good	Fair	Untreated	
22	Good	Fair	Good	Regular	Fair	Bad	Treated	
23	do	Good	do	Good	Good	Good	No choice	
24	do	do	do	do	do	do	do	
25	do	do	Fair	Fair	Fair	Fair	Treated	

TABLE XXIII.—*Twenty-two Princesas treated with hydrocyanic-acid gas and 22 untreated Princesas were used in this test.*

No. of cigar.	Treated.			Untreated.			Cigar preferred.	Remarks.
	Aroma.	Taste.	Burning quality.	Aroma.	Taste.	Burning quality.		
1	Good	Superior	Good	Bad	Regular	Bad	Treated	
2	Fair	Good	Fair	Fair	Good	Fair	No choice	
3	None	do	Good	Good	Fair	Good	Untreated	
4	Good	do	do	do	Good	do	do	
5	Ordinary	do	do	Ordinary	do	do	No choice	
6	Fair	Fair	Fair	Normal	Normal	Fair	Untreated	
7	Natural	Good	Good	do	Good	Good	No choice	
8	Poor	Poor	do	Good	do	do	Untreated	
9	Good	Good	do	do	Impaired	do	Treated	
10	Bad	Bitter	One sided	Bad	Bitter	One sided	No choice	
11	Good	Excellent	Good	Good	Fair	Good	Treated	Not so good as No. 7 (which was treated).
12	do	Good	do	do	Good	do	No choice	
13	do	do	do	do	do	do	do	
14	Fair	Fair	Fair	Fair	Fair	Fair	Treated	Thinks treated cigar superior to untreated.
15	Good	Good	Good	Good	Good	Good	No choice	Untreated slightly stronger than treated.
16	Poor	Poor	Poor	Medium	Medium	Medium	Untreated	Did not care for either.
17	Average	Average	Good	Sweet	Very good	Good	do	
18	Good	Good	do	Good	Good	do	No choice	
19	do	do	do	do	Peculiar	do	Treated	Untreated cigar stronger than treated.
20	Fair	Bitter	Fair	do	Good	do	do	Thinks treated cigar superior to untreated.
21	do	do	Good	Fair	Bitter	do	No choice	
22	Good	Good	do	Good	Good	do	do	

TABLE XXIV.—*Twenty Londres treated with carbon bisulphide and 20 untreated Londres were used in this test.*

No. of cigar.	Treated.			Untreated.			Cigar preferred.	Remarks.
	Aroma.	Taste.	Burning quality.	Aroma.	Taste.	Burning quality.		
1	Good	Good	Good	Fair	Good	Bad	Treated	
2	do	do	do	Good	do	Good	Untreated	Prefers untreated.
3	Strong	do	do	do	do	do	do	Slight difference; prefers untreated.
4	Fair	Fair	Fair	Fair	Fair	do	do	
5	do	do	Good	do	do	do	No choice	
6	Good	Good	do	do	Good	Fair	Treated	
7	do	do	do	do	Bitter	Bad	do	
8	do	do	do	Good	Fair	Good	do	
9	Fair	Fair	Fair	Fair	do	Fair	No choice	
10	Good	Good	Good	Good	Good	Good	do	
11	Poor	Bitter	Fair	Poor	Bitter	Poor	do	
12	Fair	Fair	do	Fair	Fair	Fair	do	
13	Good	Good	Good	Good	Good	Good	do	
14	do	do	do	do	do	do	do	
15	do	Fair	do	do	do	do	Untreated	
16	Poor	do	Fair	Poor	Fair	Fair	No choice	
17	Good	Good	Good	Good	Good	Good	do	
18	do	Mild	do	do	Mild	do	do	
19	do	Good	do	Strong	Bitter	do	Treated	
20	Fair	Fair	Bad	Fair	Bad	Fair	No choice	

TABLE XXV.—*Six Regalias made from steamed tobacco and 6 untreated Regalias were used in this test.*

No. of cigar.	Treated.			Untreated.			Cigar preferred.
	Aroma.	Taste.	Burning quality.	Aroma.	Taste.	Burning quality.	
1	Good	Good	Good	Good	Good	Good	No choice.
2	do	do	do	do	do	do	Do.
3	do	do	do	do	do	do	Do.
4	Fair	Medium	Fair	Fair	Fair	Fair	Treated.
5	Good	Good	Good	Good	Good	do	Do.
6	do	do	Fair	do	do	Good	Untreated.

TABLE XXVI.—*Twelve Imperiales treated with hydrocyanic-acid gas and 12 untreated Imperiales were used in this test.*

No of cigar.	Treated.			Untreated.			Cigar preferred.	Remarks.
	Aroma.	Taste.	Burning quality.	Aroma.	Taste.	Burning quality.		
1	Good	Good	Good	Good	Good	Good	No choice	
2	do	do	do	do	do	do	do	
3	do	Fair	do	do	do	do	Untreated	
4	Poor	Poor	Bad	Fair	Fair	Fair	do	
5	Good	Good	Good	Good	Good	Good	No choice	
6	Fair	Fair	Fair	Fair	Fair	Fair	Treated	Did not care for either, but thought treated cigar the best.
7	do	do	Good	do	Good	do	No choice	
8	Good	Good	do	Good	Fair	do	Treated	
9	do	Excellent	do	do	Excellent	Good	do	Preferred treated cigar.
10	Natural	Natural	Even	do	Unpleasant	Even	do	
11	Good	Good	Excellent	do	Good	Excellent	No choice	
12	do	do	Fair	do	do	Fair	do	

TABLE XXVII.—*Ten treated and 10 untreated Divinos were used in this test.*

(Filler steamed; wrapper treated with carbon bisulphide.)

No. of cigar.	Treated.			Untreated.			Cigar preferred.	Remarks.
	Aroma.	Taste.	Burning quality.	Aroma.	Taste.	Burning quality.		
1	Good	Strong	Good	Good	Mild	Fair	No choice	
2	do	Good	do	Fair	Fierce	Bad	Treated	
3	Fair	Fair	Fair	do	Fair	Fair	No choice	
4	Good	Good	Good	do	Biting	do	Treated	
5	do	do	do	Good	Good	Good	do	Preferred treated cigar.
6	do	do	do	do	do	do	No choice	
7	do	do	do	Poor	Medium	do	Treated	
8	Natural	Natural	do	Natural	Natural	do	No choice	
9	Good	Good	do	Good	Good	do	do	
10	do	Superior	do	do	do	Bad	Treated	

TABLE XXVIII.—*Summary of Tables XXII to XXVII, showing in percentages the preference of smokers for treated cigars.*

Kind of cigar.	Number of each treated and untreated.	Relative number of cigars preferred by smoker.			Relative percentages of cigars preferred by smoker.			In favor of—		Percentage gain for treated.
		Treated.	Untreated.	No choice.	Treated.	Untreated.	No choice.	Treated cigars.	Untreated cigars.	
					Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Perfectos	25	11	8	6	44	32	24	12	0.0	12
Bouquets	25	8	5	12	32	20	48	12	0.0	12
Princesas	22	6	6	10	27.24	27.24	45.4	0.0	0.0	0.0
Londres	20	5	4	11	25	20	55	5	0.0	5
Regalias	6	2	1	3	33.32	16.66	49.98	16.66	0.0	16.66
Imperiales	12	4	2	6	33.32	16.66	49.98	16.66	0.0	16.66
Divinos	10	5	0	5	50	0.0	50	50	0.0	50

It will be noted that in all cases, but one, the treated have a gain in percentage over the untreated cigars. It is not the object of this table to show that these treatments improve the different cigars but simply to show that their qualities are not impaired thereby.

THE NECESSITY FOR REMEDIAL MEASURES

Using as a basis the approximate loss of cigars due directly to the ravages of the cigarette beetle during the past three fiscal years in the 19 factories of Manila which have had an export trade, we obtain the following results:

Fiscal year.	Cigars destroyed.	Value in pesos.
1909	1,116,056	35,290.70
1910	363,303	15,205.82
1911	942,856	36,451.00
Total, 3 years	2,422,215	86,947.52

By the methods of fumigation indicated in this paper, the cost of the chemicals and installation of the necessary apparatus would be as follows:

	Pesos.
Installation of apparatus in 19 factories	11,600.00
Chemicals for fumigation	242.22
Two employees, at 6,000 pesos per annum, for three years	36,000.00
Total	47,842.22

There is shown a net saving of 39,105.30 pesos. The losses given are for cigars actually destroyed in the factories and not for that of stock lost outside of the factory, due to the same cause, or the loss of trade due to the shipment of infested stock. These cannot be accurately estimated, although it is safe to say that the greater part of the 2,539,860 pesos [12] decrease in the exports of tobacco and tobacco products to the United States alone is to be attributed indirectly to the causes set forth above. On account of the free entry of tobacco and tobacco products into the United States, the trade should have shown an increase.

Inquiries at various factories in Manila, which formerly had a good export trade with the United States, revealed the fact that many, at the present date, have no export trade at all; and some of them are running at less than one-eighth of their capacity.

CONCLUSIONS

Data concerning the remedial measures which may be applied in the various tobacco factories in Manila for combating the cigarette beetle, have been furnished, and it has been shown that this insect can be absolutely controlled by the treatments indicated.

Forty-one per cent of the annual factory loss due to insects would pay for the necessary chemicals and labor and 13 per cent for installation of proper apparatus. There would thus be a saving of 46 per cent on this stock alone. These figures do not take into account the direct loss due to this beetle outside the factories or the indirect loss of trade.

At first, the work must be carried on by persons who realize the prime importance of accuracy and the necessity for keeping treated stock free from reinfestation. In the course of time as work progresses and the ordinary laborers become familiar with the ordinary operations, the salaries may be greatly reduced.

[12] Annual report of the work of the Bureau of Customs during the fiscal year 1911.

ILLUSTRATIONS

(Plate I, drawings by Espinosa; Plate IV, photographs by Martin; Plates II, III, and V to IX, photographs by Cortes.)

PLATE I

FIGS. 1 to 7. Stages of *Lasioderma serricorne* Fabr. *1*, Egg; *2*, larva; *3*, pupa, front view; *4*, pupa, side view; *5*, pupa cell; *6*, adult, back view; *7*, adult, side view.

FIG. 8. *Norbanus* sp. Parasite of *L. serricorne*, dorsal view.

9. *Norbanus* sp. Parasite of *L. serricorne*, lateral view.

10. Larva of Clerid predaceous on pupæ and larvæ of the cigarette beetle.

FIGS. 11 and 12. Pupa of Clerid.

FIG. 13. Adult Clerid.

PLATE II

Cigars showing infestation by cigarette beetle; *a*, character of injury where larva gets between two cigars.

PLATE III

FIG. 1. Screened compartment at factory where many experiments were conducted; *a*, two screened doors, with screened vestibule.

2. Fumigating compartment showing tobacco wrapper on shelves.

PLATE IV

FIG. 1. Steam drum used in the control of the cigarette beetle. The pile of leaf tobacco at the right has been steamed; *a*, car which holds about 120 kilograms of leaf tobacco; *b*, track to transfer car in and out of drum *d*; *c*, hinge joint where track swings back when door closes.

2. A revolving steam drum.

PLATE V

FIG. 1. Cigars dried out on open rack where the cigarette beetles have free access. A source of infestation.

2. Cigars in drying cabinet. A source of infestation.

PLATE VI

FIG. 1. Open mandalas (fermenting piles) to which the beetles have free access. These piles are infested at all times. The tobacco from these piles is taken to the work room and made directly into cigars.

2. Closed mandala which gives as satisfactory results as the open one. The beetles are practically excluded. The numbered sections of the open side fit in a grove at either end and may be removed from top to bottom.

PLATE VII

FIG. 1. Bodega (warehouse) showing how tobacco is stored. This tobacco is infested at all times.

2. Tobacco stored in stripping room. Badly infested, it furnishes a supply of beetles for the newly stripped filler and wrapper.

PLATE VIII

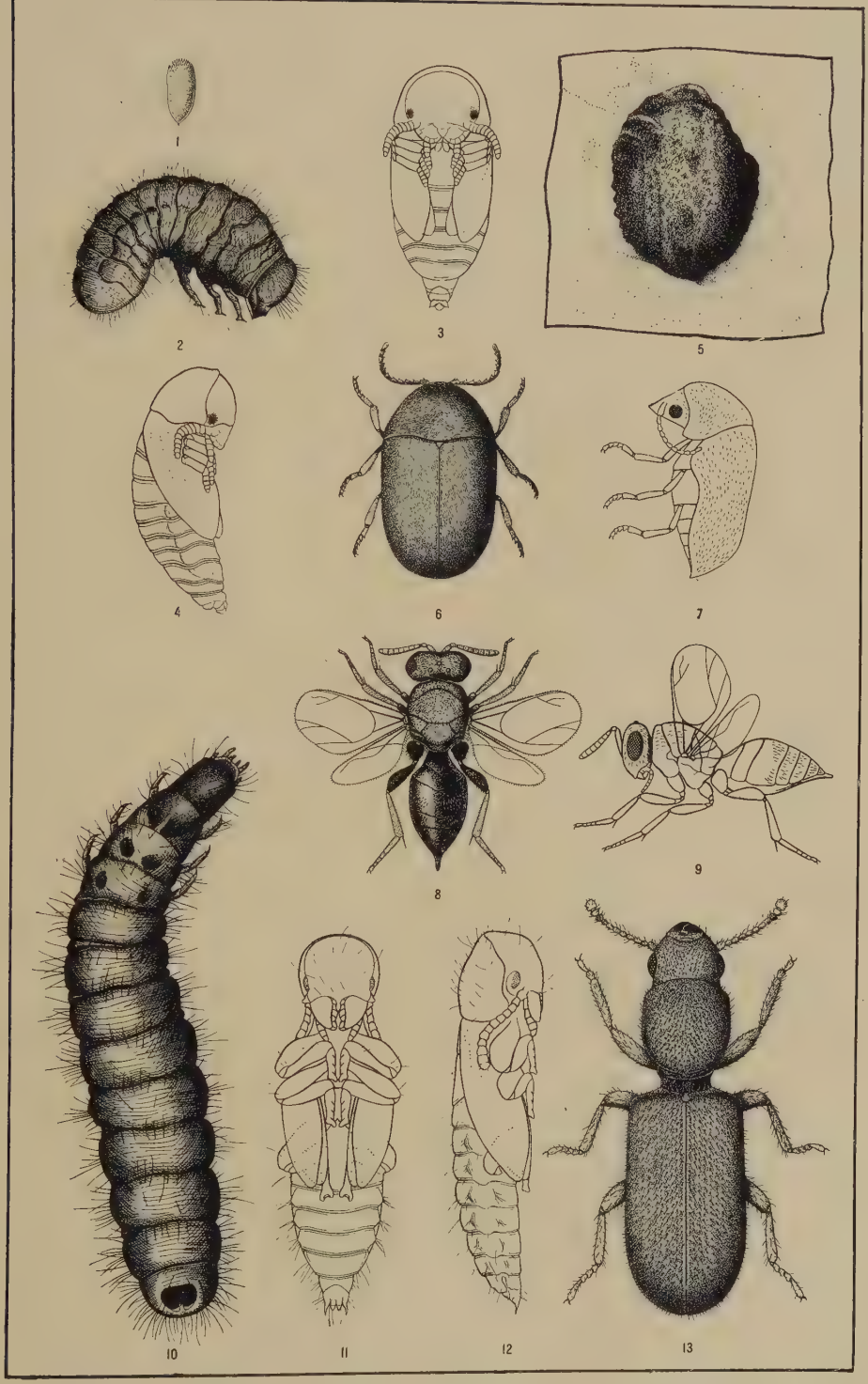
FIG. 1. Manos (hands) of first class tobacco. They contain 100 leaves each.

2. Apparatus used for testing cigars fumigated with hydrocyanic acid for the presence of cyanides and for testing the burning quality of the cigars. *a*, rubber nipple for holding the cigars; *b*, connected y-tubes for smoking a series of 4 cigars; *b'*, stand for support; *c c*, Wolfe's bottles with saturated solution of silver nitrate through which the smoke was passed; *c' c'*, glass tubes which conduct smoke into solution of silver nitrate; *d*, u-tube to catch any solution that may pass from *c; e*, stopcock by which suction is regulated; *f*, large jar of water which when syphoned through tube *g* furnishes draught.

PLATE IX

FIG. 1. Wrapper tobacco showing injury caused by larvæ of the cigarette beetle.

2. Freshly painted doors of a bodega where thousands of adult cigarette beetles were caught during one evening. Each small black dot is an adult cigarette beetle.



Figs. 1–7. *Lasioderma serricorne* Fabr., 8 and 9 *Norbanus* sp., 10–13 *Clerid beetle.*

PLATE I.

PLATE II. CIGARS INJURED BY CIGARETTE BEETLES.

Fig 1. Screened compartment at factory; *a*, one of the two screened doors with screened vestibule.

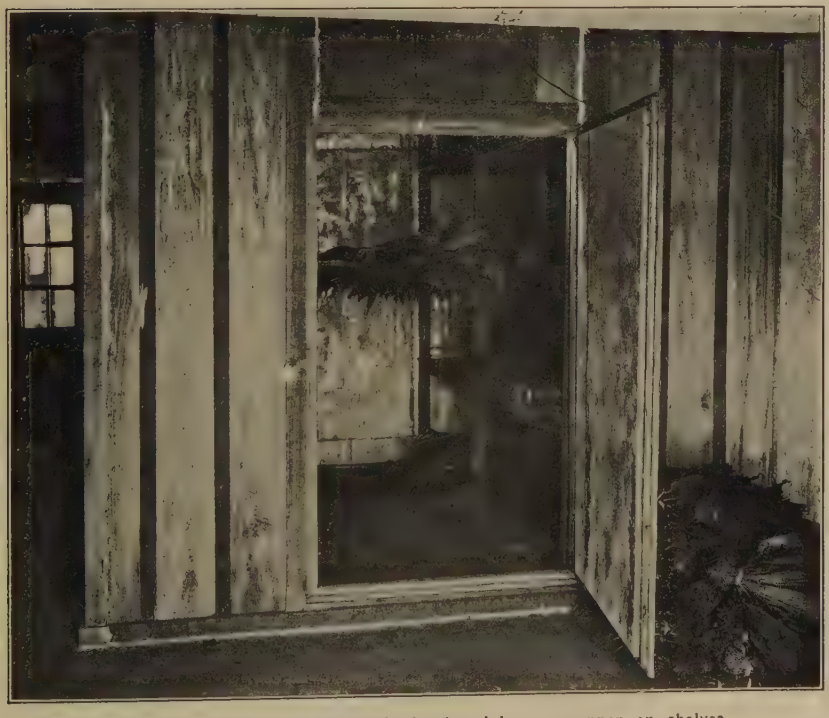


Fig. 2. Fumigating compartment showing tobacco wrapper on shelves.

PLATE III.

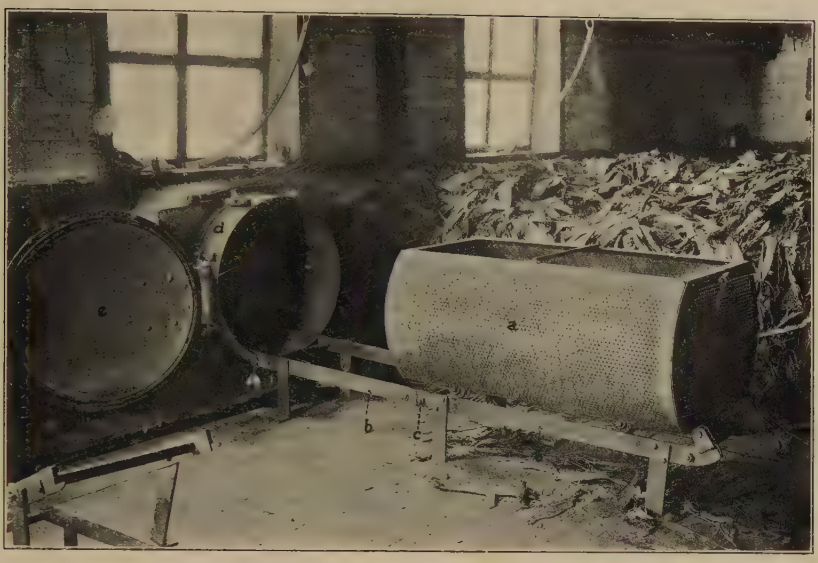


Fig. 1. Steam drum used in the control of the cigarette beetle.

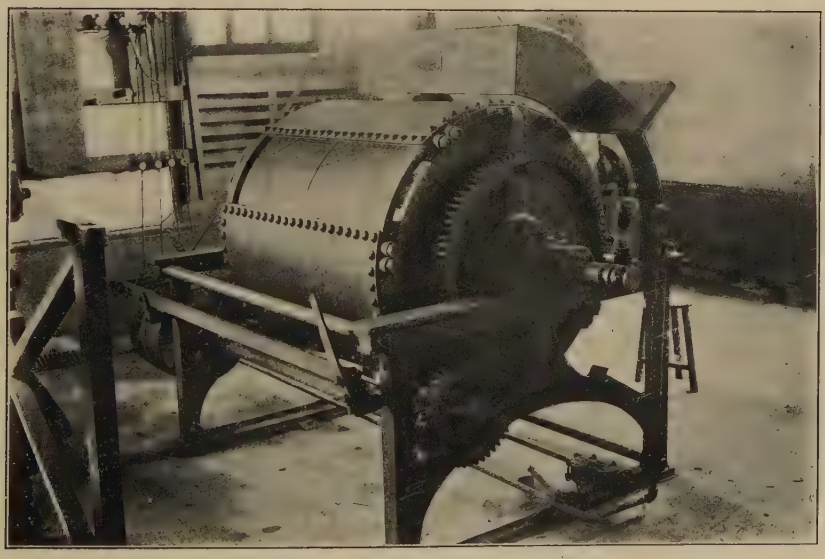


Fig. 2. A revolving steam drum.

PLATE IV.

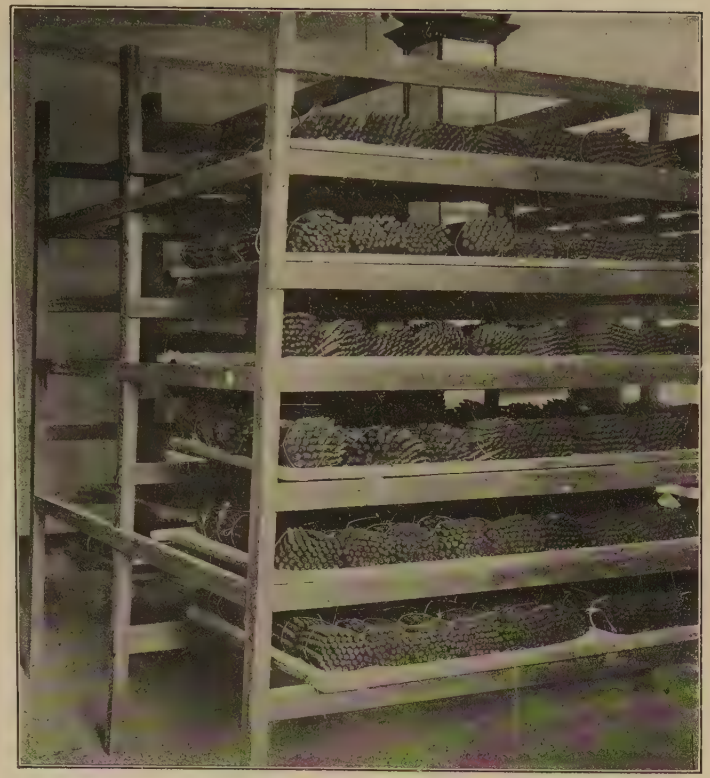


Fig. 1. Cigars dried on open rack.

Fig. 2. Cigars in drying cabinet.

PLATE V.

Fig. 1. Open mandalas (fermenting piles) to which beetles have free access.

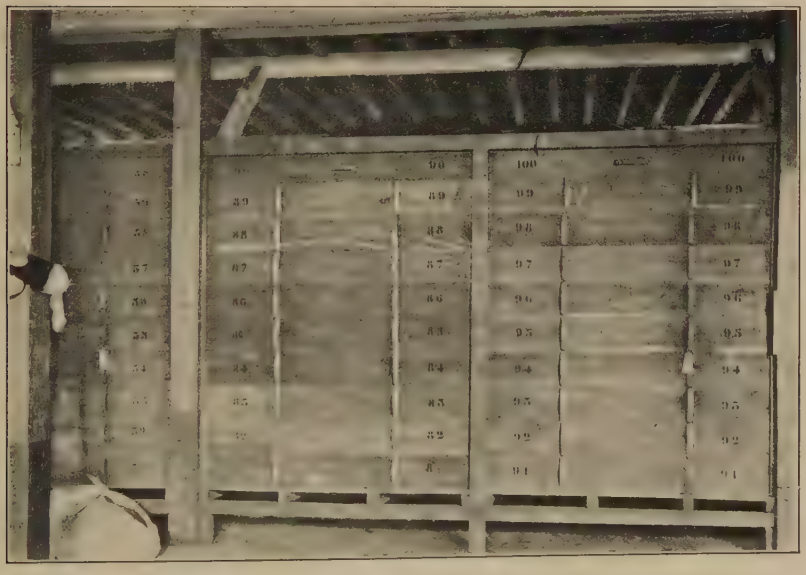


Fig. 2. Closed mandala which gives as satisfactory results as the open one.

PLATE VI.

Fig. 1. Bodega (warehouse) showing how tobacco is stored.

Fig. 2. Tobacco of the crop of 1908 stored in stripping room.

PLATE VII.

Fig. 1. Manos (hands) of first-class tobacco.

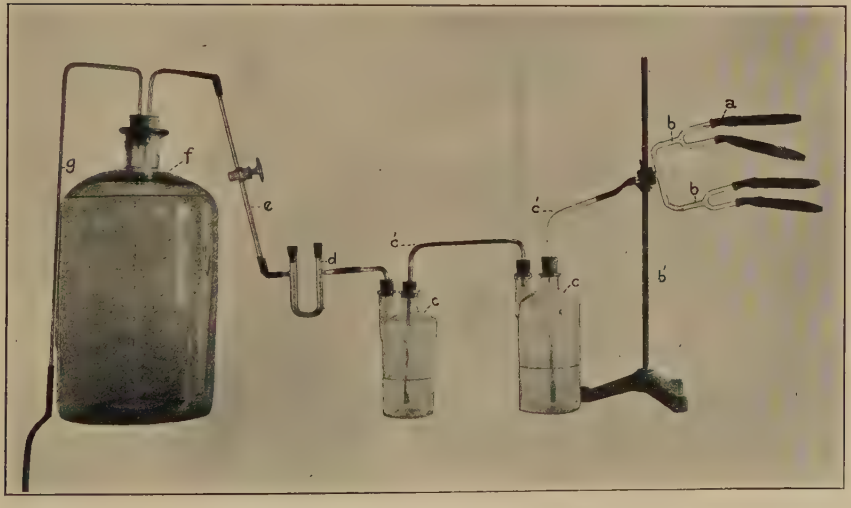


Fig. 2. Apparatus used for testing cigars.

PLATE VIII.

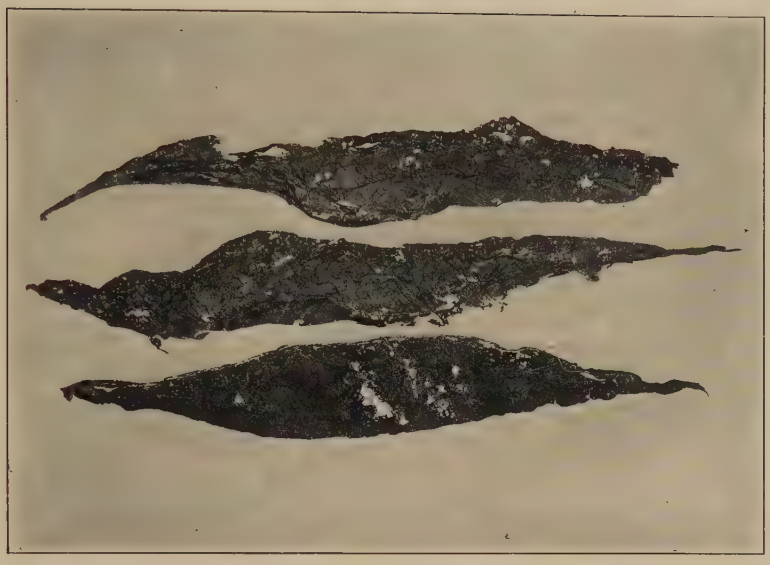


Fig. 1. Wrapper tobacco injured by larvæ of the cigarette beetle.

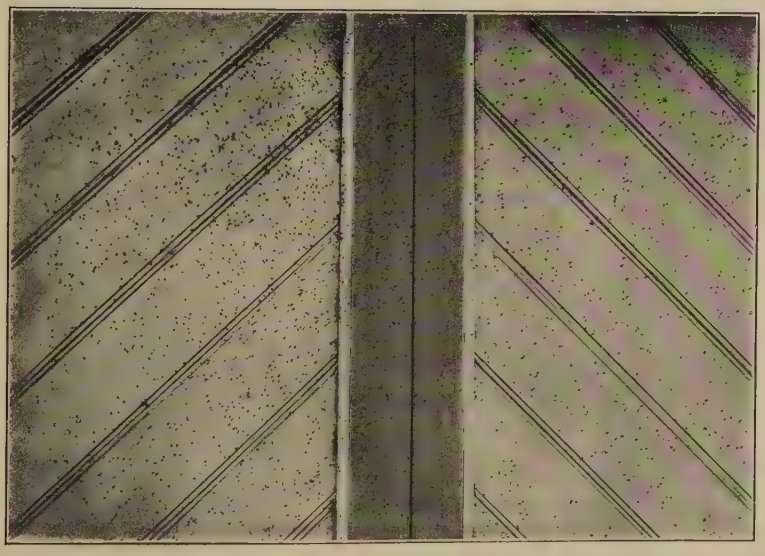


Fig. 2. Freshly painted doors of a bodega showing adult cigarette beetles.

PLATE IX.

LAGRIIDEN UND ALLECULIDEN DER PHILIPPINEN

(COLEOPTERA)

Von FRITZ BORCHMANN

(*Hamburg, Germany*)

Eine kleine, aber sehr interessante Sammlung von Lagriiden, Alleculiden und Meloiden, die mir vom Bureau of Science in Manila zur Bestimmung übergeben wurde, reifte in mir den Entschluss, eine Übersicht über die Fauna der ersten Gruppe zu geben. Die neuen Arten finden im Anschlusse daran ihre Beschreibung, denen ich die Beschreibung einiger neuer Arten aus anderen Sammlungen hinzufüge. Es waren bisher 4 *Lagria*-Arten und 1 *Casnonidea* von den Philippinen bekannt. Diese und die neuen Arten scheinen weder auf dem Festlande noch auf den andern Inselgruppen, vielleicht mit Ausnahme von Celebes, vorzukommen. Die Fauna enthält also auffallend viele endemische Arten. Manche Tiere scheinen in der Färbung ausserordentlich zu variieren. Daher sind bei der verhältnismässigen Seltenheit der Tiere die Arten oft recht schwierig zu trennen.

I. LAGRIIDAE

LAGRIA Fabricus

1. **Lagria cribratula** Schauf.
Von Celebes.

2. **Lagria pruinosa** Chevr.
In 3 typischen Exemplaren von LUZON, Benguet, Cabayan (11439, 11503, *R. C. McGregor*).

3. **Lagria ionoptera** Er.
LUZON, Rizal, Montalban Gorge (5197, 5626, *Charles S. Banks*).

4. **Lagria prasinella** Fairm.
Die 4 Exemplare weichen durch ihre trübe Färbung ab. Sie haben einen starken rötlichen Schimmer.
LUZON, Benguet, Baguio (9924, *H. M. Curran*); Bued River (9873, *H. M. Curran*); Cagayan, Tuguegarao (10482, *H. M. Curran*); NEGROS, Negros Occ., Mt. Canlaon (129031, *Charles S. Banks*).

5. **Lagria hirticollis** Borchm.

PALAWAN, Iwahig (12359, *C. M. Weber*).

Ich beschrieb die Art von Pegu und Sarawak, Borneo.

6. **Lagria concolor** Blanch.

LUZON, Bataan, Lamao (9820, *H. E. Stevens*); NEGROS, Negros Occ., Nakalang (1396, *Charles S. Banks*); MINDANAO, Agusan River (13694, *W. Schultze*).

Die Art ist über einen grossen Teil des Festlandes und der Inselflur verbreitet.

7. **Lagria fulgidipennis** sp. nov.

Länglich, nach hinten etwas erweitert, stark gewölbt; Flügeldecken stark glänzend; kurz, fein und dicht behaart; schwarz, oft mit grünlichem oder dunkelblauem Schimmer, Kopf und Halsschild mit schwachem, grünen Erzschimmer, Flügeldecken mit starkem, dunkelgrünem Erzchimmer. Kopf rundlich, stark und dicht punktiert; Oberlippe kurz, vorn stark ausgerandet, Ecken, abgerundet, lang braun beborstet. Clypeus 2 mal so lang, vorn ausgerandet, dicht und grob punktiert, beborstet, von der Stirn durch eine tiefe gerade Querfurche getrennt, Stirn wenig gewölbt, uneben; Schläfen lang, gerundet; letztes Glied der Kiefertaster kurz, breit dreieckig, Aussenseite am längsten; Fühler mässig stark, die Schultern wenig überragend, nach aussen nicht verdickt, vom 5. Gliede an fast walzenförmig, 3. Glied wenig länger als das 4., Endglied etwas länger als das 10., gebogen, zugespitzt; Augen nierenförmig, stark gewölbt, Stirnabstand fast gleich 3 Augendurchmessern. Halsschild breiter als der Kopf mit den Augen, breiter als lang, nahe dem Vorderrande am breitesten, ziemlich stark gewölbt, grob und dicht punktiert, ein Exemplar hat einen deutlichen Mittelkiel, am Anfang des 2. Drittels beiderseits neben dem Kiel eine tiefe Grube, das 2. Exemplar hat keinen Mittelkiel, dafür aber an jeder Seite des Halsschildes 2 hinter einander stehende Gruben, alle Ränder des Schildes deutlich gerandet, Vorderecken stumpf, Hinterecken etwas vortretend, Hinterrand in der Mitte etwas ausgebuchtet; Schildchen rundlich, dicht punktiert, braun behaart; Flügeldecken nicht ganz doppelt so breit wie der Halsschild, stark gewölbt, mässig erweitert, Schultern stark gefaltet, etwas vorgezogen, hinter dem Schildchen flach quer niedergedrückt, Spitzen zusammen abgerundet, Scheibe mit einer beträchtlichen Zahl mässig starker, nicht scharf abgegrenzter Längsrippen, überall gleichmässig, ziemlich fein, nicht dicht punktiert; Epipleuren breit, allmählich verengt, weitläufig punktiert. Unterseite fein und ziemlich dicht punktiert, glänzender

als Kopf und Halsschild, Seiten des starkgewölbten Abdomens mit rundlichen Eindrücken, Abdominalfortsatz breit und kurz, breit gerandet. Beine braun behaart, Schenkel schwach verdickt, Schienen schwach gebogen, Hinterschenkel den Hinterrand des 3. Hinterleibsringes nicht erreichend, Füsse mit gelb beborsteter Sohle, 1. Tarsenglied der Hinterfüsse so lang wie die folgenden Glieder zusammen.

2 ♀ ♀. Länge: 19–20 mm.; Schulterbreite: 7 mm.

NEGROS, Mt. Canlaon, 800 m. (6456, *Charles S. Banks*).

Type ♀, in meiner Sammlung.

Die Art lässt sich schwer mit anderen vergleichen. Sie ist am nächsten mit *Lagria denticornis* Fairm. und *crassa* Borchm. verwandt, aber durch Färbung und Skulptur grundverschieden.

CEROGRIA Borchmann

8. Cerogria dohrni Borchm.

Cerogria dohrni BORCHM., Bull. Soc. Ent. Ital. (1909), 41, 212.

Luzon.

9. Cerogria meloides Borchm.

Cerogria meloides BORCHM., Bull. Soc. Ent. Ital. (1909), 41, 218.

Philippinen.

Genauere Fundorte sind mir nicht bekannt.

NEOGRIA Borchmann

10. Neogria concolor Borchm.

Neogria concolor BORCHM., Bull. Soc. Ent. Ital. (1909), 41, 225.

LUZON, Benguet, Irisan (973, *R. C. McGregor*).

Ich beschrieb diese Art von der Insel Mentawei.

CASNONIDEA Fairmaire

Die Gattung *Casnonidea* ist kaum von der Gattung *Nemostira* Fairm. zu trennen obgleich es sehr wünschenswert wäre. Auch *Hysterarthron* Thoms. gehört wahrscheinlich hierher. Dann müsste wenigsten *Nemostira* eingezogen werden. Als durchgreifender Unterschied zwischen den beiden ersten Gattungen führt der Autor an: Bei *Casnonidea* ist der Kopf breiter als der Halsschild; die Augen sind unterseits beträchtlich von einander entfernt und vorn nicht ausgerandet. Der Abdominalfortsatz ist schmal und über die Hüften verlängert. Als wichtigstes Merkmal wird angeführt, dass die Oberlippe nach der Basis und das Epistom nach dem Apex verengt ist, so dass die Mandibeln sichtbar sind.

Bei *Nemostira* ist der Halsschild breiter als der Kopf; die Augen sind vorn ausgerandet und stossen unterseits fast zusammen. Der Abdominalfortsatz ist breit und abgestutzt. Oberlippe und Epistom sind nicht verengt und bedecken die Mandibeln vollkommen. Alle angeführten Merkmale sind graduelle; keine gehen durch. Es gibt überall Übergangsformen in allen Graden. Oft sind die Merkmale gemischt. In der folgenden Zusammenstellung fasse ich als *Casnonidea* die Formen auf, die verengte Oberlippe und verengtes Epistom haben.

I. Hinterschienen des Männchens einfach.
A. Flügeldecken einfarbig.

11. **Casnonidea albopilosa** Schauf.
Vom Autor als *Lagria* von Celebes beschrieben.

12. **Casnonidea atricapilla** Fairm.
Süd-Celebes, Bantimoeroeng.

13. **Casnonidea impressifrons** Schauf.
Von Celebes als *Lagria* beschrieben.

14. **Casnonidea mollis** sp. nov.

Form der *Nemostira villosa* Borchm., etwas buckelig gewölbt, nach hinten mässig erweitert; glänzend rotbraun, Oberseite und äussere Hälfte der Schenkel und die Schienen dunkel metallisch grün, Augen und Fühler schwarz; glänzend; lang, ziemlich dicht und etwas anliegend, gelblich behaart. Kopf wie gewöhnlich, Oberlippe doppelt so breit wie lang, Ecken wenig abgerundet, vorn schwach ausgerandet, dicht punktiert, mit langen weisslichen Haaren; Clypeus etwas länger, ebenso skulptiert, von der Stirn durch einen flachen, gebogenen Eindruck getrennt; Stirn und Scheitel uneben, grob punktiert, letzterer mit einer kräftigen Mittelrinne; Schläfen kurz; Hals scharf abgesetzt; letztes Glied der Kiefertaster mässig breit dreieckig. Fühler die Schultern etwas überragend, kräftig, Glieder gestreckt, 3. Glied so lang wie das 4., Endglied kaum länger als das vorhergehende, fast gerade, etwas verdickt und dann plötzlich zugespitzt; Augen nierenförmig, gewölbt, Abstand unten gross, auf der Stirn $1\frac{1}{2}$ Augendurchmesser. Halsschild sehr wenig breiter als der Kopf mit den Augen, so lang wie breit, gewölbt, vorn stark gerundet, hinten etwas eingeschnürt, Hinterwinkel etwas vortretend, vorn fein, hinten breit, aufgebogen gerandet, Scheibe grob und nicht dicht punktiert, vor dem Hinterrande quer eingedrückt. Schildchen sehr klein, glänzend, glatt, mit leichtem Längseindruck, Spitze abgerundet. Flügel-

decken am Grunde doppelt so breit als der Halsschild, nach hinten etwas erweitert, gewölbt, Schultern rechtwinklig abgerundet, Spitzen zusammen abgerundet, Scheibe skulptiert wie bei *Nemostira villosa* Borchm., gestreift-punktiert, Zwischenräume flach, quer gerunzelt, Epipleuren schmal, grob punktiert. Unterseite stark glänzend, mit zerstreuten, groben, borstentragenden Punkten. Abdominalfortsatz kurz, breit, scharf und aufgebogen gerandet, Spitze etwas abgerundet. Beine lang behaart, Schenkel schwach verdickt, Schienen fast gerade, Hinterschenkel den Hinterrand des 3. Segmentes kaum überragend. Erstes Tarsenglied der Hinterfüsse so lang wie die folgenden Glieder zusammen.

2 ♀ ♀. Länge: 11–12.5 mm.; Schulterbreite: 3 mm.

LUZON, BENGUET, Irisan (971 und 1475, *R. C. McGregor*).

Type ♀, No. 971 in der Sammlung des Bureau of Science, Manila.

Die Art ist nahe verwandt mit *impressifrons* Schauf. und *villosa* Borchm. Sie unterscheidet sich von beiden durch ihre Färbung und die viel stärkere Wölbung der Flügeldecken. Auch *albopilosa* Schauf. gehört in diese Gruppe.

15. **Casnonidea perforata** sp. nov.

Gestreckt, nach hinten wenig erweitert, gewölbt, ausser den Beinen fast unbehaart; mässig glänzend; gelbbraun, Kopf mit Ausnahme des Clypeusrandes metallisch dunkel schwarzgrün, Augen und Fühler schwarz, Oberseite des Halsschildes rötlich, Flügeldecken wie der Kopf gefärbt, die Naht und die Epipleuren schmal, gelbbraun, Beine mit Ausnahme der gelben Schenkelbasis von der Farbe der Flügeldecken. Kopf typisch; Oberlippe quer, gewölbt, glänzend, vorn fast gerade, mit wenigen grossen Punkten; Clypeus skulptiert wie die Oberlippe, ebenso lang, Vorderrand gerade, gelb, von der Stirn durch eine tiefe gebogene Querfurche abgesetzt, Stirn mit einigen groben Punkten, sehr uneben, zwischen den Augen der Länge nach stark eingedrückt, Schläfen kurz, grob punktiert, plötzlich in den fast unpunktierten Hals verengt; letztes Glied der Kiefertaster messerförmig, zugespitzt; Fühler gleich der halben Körperlänge, schlank, die ersten 7 Glieder gestreckt, walzig, an der Spitze wenig breiter, 3. Glied wenig länger als das 4., 8.–10. Glied dreieckig, kurz, etwas abgeplattet, Endglied walzenförmig, schwach gebogen, fast so lang wie die 4 vorhergehenden Glieder zusammen; Augen stark gewölbt, nierenförmig, unten und oben stark genähert, Stirnabstand gleich $\frac{1}{2}$ Augendurchmesser von oben gesehen. Halsschild breiter als der Kopf mit den Augen, so lang wie

breit, gewölbt, dicht und grob punktiert, Vorderecken stark abgerundet, Seiten unmittelbar vor dem Hinterrande eingeschnürt, Hinterecken etwas vortretend, Vorder- und Hinterrand gerade, Vorderrand fein, Hinterrand stark aufgebogen gerandet. Schildchen rundlich, gelb, äusserst fein punktiert, mit einer feinen Mittelrinne. Flügeldecken nach hinten schwach erweitert, doppelt so breit als der Halsschild, Schultern fast rechtwinklig, Spitzen der Decken zusammen abgerundet, Scheibe sehr dicht, ziemlich grob, sehr tief, fast gereiht-punktiert, Punkte grösser als die Zwischenräume; Epipleuren schmal, weitläufig, flach punktiert. Unterseite glänzender, Brust weitläufig grob, Abdomen sehr zerstreut und sehr fein punktiert, Seiten uneben, mit einigen groben Punkten; Abdominalfortsatz breit, Spitze abgerundet, mässig breit gerandet. Beine mässig lang, schlank, Hinterschenkel den Hinterrand des 3. Segmentes überragend, Schenkel schwach verdickt, Schienen schwach gebogen; Füsse mit gelbbebosteten Sohlen; 1. Tarsenglied der Hinterfüsse etwas kürzer als die folgenden Glieder zusammen.

Länge: 13 mm.; Schulterbreite: 4 mm.

Type ♂, MINDANAO, Davao, in meiner Sammlung.

16. **Casnonidea mimica** sp. nov.

Von derselben Form und Grösse wie die vorige Art, ebenfalls in der Form und Skulptur des Halsschildes und der Flügeldecken übereinstimmend, unterscheidet sie sich hauptsächlich durch die Farbe. Rotgelb, Kopf und Oberseite des Halsschildes dunkel metallisch blaugrün, Vorderrand des Clypeus gelb, Halsschild am Hinterrande schmal rotgelb gesäumt, Schildchen rotgelb, Flügeldecken braunrot mit schwachem, grünlichem Scheine, Epipleuren heller, Beine mit Ausnahme der rotgelben Schenkelbasis metallisch blaugrün, Fühler und Augen schwarz. Glieder 8–10 der Fühler sind nicht stark verbreitert, nur verkürzt. Im übrigen zeigen alle Teile grosse Übereinstimmung mit denen der vorigen Art. Vielleicht ist *mimica* nur eine Farbenvarietät.

Länge: 13 mm.; Schulterbreite: 3 mm.

1 ♂, MINDANAO, Camp Keithley (*Frau M. S. Clemens*).

Type ♂, No. 7297 des Bureau of Science, Manila, in meiner Sammlung.

Diese beiden Arten lassen sich weder bei *Nemostira* noch *Casnonidea* befriedigend unterbringen. Ausser anderen Eigentümlichkeiten (Fühlerbildung) macht die Flügeldeckenskulptur Schwierigkeiten. Die Arten könnten einer neuen Gattung zugewiesen werden.

17. Casnonidea tenera sp. nov.

Sehr gestreckt, gewölbt, glänzend, rotbraun, letztes Glied der Kiefer- und Lippentaster, die letzten Glieder der Fühler, die äusserste Spitze der Tibien und der Apex der Fussglieder leicht gebräunt, Augen schwarz, Flügeldecken dunkelbraun mit starkem blauen Glanze; oben nur am Kopfe und unten nur an den Beinen behaart. Kopf wie gewöhnlich; Oberlippe fast doppelt so breit als lang, Vorderrand gerade, Ecken stark abgerundet, Basis stark verengt, wenige zerstreute Punkte mit langen hellen Borsten; Clypeus stark glänzend, gewölbt, skulptiert wie die Lippe, von der Stirn durch eine gebogene glatte Furche getrennt; Stirn gewölbt, glatt, am Vorderrande mit einer dreieckigen Grube, Schläfen kurz, nach hinten etwas vortretend, Scheitel und Schläfen mit einigen Borstenpunkten, Endglied der Kiefertaster typisch; Fühler fadenförmig, die Mitte des Körpers nicht erreichend, fein gelblich behaart, 3. und 4. Glied gleich, Endglied so lang wie die 3 vorhergehenden Glieder zusammen; Augen sehr wenig ausgerandet, gewölbt, Stirnabstand nicht ganz $\frac{1}{2}$ Augendurchmesser. Halsschild schmäler als der Kopf mit den Augen, länger als breit, fast walzenförmig, Vorder- und Hinterrand gerade, Seiten vorn wenig gerundet, Vorderecken schwach gerundet, Hinterecken stark vorspringend, Vorderrand fein, Hinterrand breit und stark aufgebogen gerandet, Scheibe fein und zerstreut punktiert, vor dem Hinterrande quer eingedrückt. Schildchen dreieckig, glatt, Spitze etwas abgerundet. Flügeldecken fast doppelt so breit wie die Halsschildbasis, Seiten parallel, Schultern kräftig, etwas beulig, Spitzen zusammen eine etwas stumpfe Spitze bildend, Scheibe punktiert-gestreift, Punkte nach der Spitze zu sehr flach, Zwischenräume flach, nach den Seiten gewölbter, glatt, Apex mit einigen langen Borsten; Epipleuren schmal, etwas uneben, nicht sichtbar punktiert. Unterseite stark glänzend, Seiten der Brust und des Abdomens mit einigen groben Punkten, Mitte glatt, mit sehr wenigen langen Borsten; Abdominalfortsatz gleichseitig dreieckig, fast spitz, kräftig gerandet. Beine, Schenkel wenig verdickt, Hinterschenkelspitze den Hinterrand des 3. Segments überragend, Schienen gerade, mit dunklen Borsten; 1. Tarsenglied der Hinterfüsse so lang wie die folgenden Glieder zusammen; Fusssohlen wie gewöhnlich.

Länge: 11.5 mm.; Schulterbreite: 3 mm.

LUZON, La Laguna, Mt. Banajao (*Charles S. Banks*).

Type (♂ ?), No. 7176 des Bureau of Science, Manila, in meiner Sammlung.

Die Art ähnelt auffallend gewissen *Statira*-Arten. Sie unterscheidet sich von ihren Verwandten leicht durch ihre schmale Gestalt und ihre schöne Färbung.

B. Flügeldecken mit dunklem Apicalfleck.

18. **Casnonidea colon** sp. nov.

Gestreckt, gewölbt, stark glänzend, nach hinten nicht erweitert, fast unbehaart; lebhaft braungelb, Kopf mit Ausnahme der Oberlippe und des Clypeus und eine rundliche Makel dicht vor der Spitze jeder Flügeldecke glänzend schwarz. Kopf wie gewöhnlich. Oberlippe fast doppelt so breit wie lang, gewölbt, zerstreut punktiert, lang beborstet, vorn sehr schwach ausgerandet, nach hinten sehr schwach verengt; Clypeus ebenso breit wie die Lippe, etwas buckelig gewölbt, fast glatt, von der Stirn durch eine tiefe, wenig gebogene Furche getrennt; Stirn glatt, gewölbt, mit 2 parallelen Längsrinnen, Scheitel mit einer tiefen strichförmigen Grube; Schläfen sehr kurz, unpunktiert. Letztes Glied der Kiefertaster mässig breit, Spitze abgerundet; Fühler mässig dick, fadenförmig, kürzer als die halbe Körperlänge, 3. und 4. Glied gleich, Endglied so lang wie die 4 vorhergehenden Glieder zusammen, schwach gebogen, walzenförmig; Augen nierenförmig, mässig ausgerandet, gewölbt, Stirnabstand gleich einem Augendurchmesser. Halsschild $1\frac{1}{2}$ mal so breit wie der Kopf mit den Augen, so breit wie lang, fast kugelig, glatt, Vorderrand fein, Hinterrand stark aufgebogen gerandet, Vorderecken völlig verrundet, Hinterecken stark vortretend. Schildchen rundlich, glatt. Flügeldecken doppelt so breit wie die Halsschildbasis, parallel, gewölbt, gestreift-punktiert, Punkte gross und tief, nach hinten erlöschend, Zwischenräume ziemlich gewölbt, glatt, Schultern kräftig, Spitzen einzeln abgerundet; Epipleuren schmal, glatt. Unterseite glatt, nur die Seiten der Brust und des Abdomens mit zerstreuten groben Punkten. Abdominalfortsatz breit, Spitze wenig abgerundet, breit gerandet. Beine, Schenkel wenig verdickt, Schienen fast gerade, Spitze der Hinterschenkel überragt den Hinterrand des 3. Segmentes; Füsse wie gewöhnlich; 1. Tarsenglied der Hinterfüsse etwas länger als die folgenden Glieder zusammen.

Länge: 12 mm.; Schulterbreite: 3.5 mm.

1 ♂ von LUZON, gesammelt von *J. Röseler*, Naturhistorisches Museum in Hamburg. Diese neue Art hat grosse Ähnlichkeit mit *Casnonidea terminata* Fairm., unterscheidet sich aber gleich durch die abweichend gefärbten Beine und den sehr schmalen Kopf.

II. Hinterschienen des Männchens der Länge nach ausgehöhlt.

19. Casnonidea serra sp. nov.

♂, ziemlich schmal, nach hinten wenig erweitert, gewölbt, mässig glänzend, ausser den Beinen fast unbehaart; schwarz, Flügeldecken pechschwarz, mit bläulichem Scheine, Fühler braun, Spitze dunkler, Vorderrand des Clypeus gelblich; Kopf wie gewöhnlich; Oberlippe fast doppelt so breit als lang, Vorderrand fast gerade, Ecken abgerundet, Scheibe schwach und weitläufig punktiert, mit einzelnen langen Borsten, Clypeus so lang wie die Oberlippe, ebenso punktiert, gewölbt, von der Stirn durch eine gebogene, glatte Furche getrennt; Stirn fast glatt, vorn und zwischen den Augen ein ziemlich tiefer Eindruck, neben jedem Auge eine glatte Linie; Schläfen kurz, grob, runzelig punktiert, plötzlich in den stark abgesetzten Hals verengt. Letztes Glied der Kiefertaster schmal, messerförmig, 2. Glied nach der Spitze sehr verbreitert, 1½ mal so lang wie das 3., 4. zweimal so lang wie das 3.; Fühler gleich der halben Körperlänge, nach aussen nicht verdickt, alle Glieder länger als breit, vom 3. bis zum 10. allmählich kürzer werdend, 3. etwas länger als das 4. Glied, Endglied so lang wie die 4 vorhergehenden zusammen, etwas gebogen, zugespitzt. Augen nierenförmig, stark gewölbt, oben mehr als unten genähert, Stirnabstand gleich ½ Augendurchmesser. Halsschild etwas breiter als der Kopf mit den Augen, so lang wie breit, vor der Mitte gerundet erweitert, nach dem Hinterrande verengt, Vorderwinkel abgerundet, Hinterwinkel vortretend, Vorderrand fast gerade, fein gerandet, Hinterrand stark aufgebogen, Scheibe etwas flach gedrückt, grob und zerstreut punktiert, mit einer eingedrückten Mittellinie und einer ziemlich breiten Grube vor dem Hinterrande. Schildchen rundlich, glatt. Flügeldecken 1½ mal so breit wie der Halsschild, 2½ mal so lang wie breit, nach hinten wenig erweitert, zusammen zugespitzt, Seiten vor der Spitze schwach ausgerandet, Schultern rechtwinklig abgerundet, Scheibe am Ende des 1. Viertels quer, flach eingedrückt, gestreift-punktiert, Punkte in den Streifen tief und dicht, Zwischenräume schwach gewölbt, mit ziemlich groben Punktreihen, deren einzelne Punkte in unregelmässigen Abständen von einander stehen; Epipleuren schmal, glatt, etwas uneben. Unterseite und Beine sehr fein und zerstreut, die Seiten der Brust grob punktiert. Abdomen an den Seiten wenig uneben, letztes Segment am Hinterrande gelb, mit einer flachen Grube. Abdominalfortsatz breit, nur die äusserste Spitze abgerundet, mässig breit gerandet. Beine lang, kräftig, Spitze der Hinterschenkel den Hinterrand des 5. Segmentes erreichend, Schen-

kel ziemlich dick, Schienen gebogen, Hinterschienen 2 mal. Sie sind merkwürdig gestaltet. Sie sind in der Vorder- und Seitenansicht je 2 mal gebogen, die Spitze der Schiene ist vorn ausgeschnitten und die Hinterkante der Schiene verbreitert und kahnförmig ausgehöhlt, die Höhlung mit langen gelben Haaren bekleidet, die Ränder der Höhlung sind mit einer Reihe von Sägezähnen besetzt, die Spitze der Schiene ist dann noch, seitlich gesehen, stark verschmälert. Sohle der Füsse gelb beborstet; 1. Tarsenglied der Hinterfüsse so lang wie die folgenden Glieder zusammen.

♀, gestreckt, parallel. Clypeus, Fühler mit Ausnahme der 3 äussersten Glieder, Oberseite des Halsschildes, das Schildchen, der hintere Teil der Epipleuren, die Hüften und die Beine mit Ausnahme des Klauengliedes und ein grosser Fleck auf dem Metasternum rötlich braungelb; ausser einigen langen Borsten am Kopf und der steifen Beborstung der Tarsen und Tibien kahl. Kopf weitläufig und grob punktiert, Oberlippe quer, Ecken abgerundet, vorn schwach ausgerandet, stark glänzend, mit spärlichen, langen, weisslichen Borsten, Basis verengt; Clypeus, sehr uneben; letztes Glied der Kiefertaster dreieckig; Fühler schlank, nach aussen wenig verdickt, Endglied so lang wie die 3 vorhergehenden Glieder zusammen, walzenförmig. Halsschild grob und weitläufig punktiert, mit schwacher Längsrinne; Schildchen klein, zungenförmig, mit deutlicher Mittelfurche. Flügeldecken im 1. Viertel mit einem schwachen Quereindruck, Schultern rechtwinklig abgerundet. Beine kräftig, Schenkel mässig verdickt, Spitze der Hinterschenkel den Hinterrand des 4. Segmentes erreichend. Schienen schwach gebogen. Erstes Tarsenglied der Hinterfüsse so lang wie die 2 folgenden Glieder zusammen.

Länge: ♀ 14 mm.; Schulterbreite: 4.5 mm. ♂ 13 mm.; Schulterbreite: 4 mm.

BATAN, Batanes (*R. C. McGregor*).

Type ♀, No. 7783 in der Sammlung des Bureau of Science, Manila. ♂ in meiner Sammlung.

20. Casnonidea diversipes sp. nov.

Gestreckt, gewölbt, glänzend, ausser Kopf und Beine unbehaart; pechschwarz, Kopf schwarz, Halsschild und Flügeldecken mit starkem, blauem Metallschimmer. Kopf wie gewöhnlich; Oberlippe doppelt so breit als lang, vorn gerade, nach der Basis verengt, Vorderecken abgerundet, gewölbt, mit zerstreuten Punkten, lang beborstet; Clypeus stark glänzend, sehr fein und zerstreut punktiert, so lang wie die Lippe, von der Stirn durch

eine gebogene, glatte Furche getrennt; Stirn sehr fein punktiert, grob längsrunzlig; Schläfen schmal, allmählich gerundet, mit einigen groben Punkten; Fühler fadenförmig, 3. Glied länger als das 4., das 10. und 11. Glied fehlen den vorliegenden Tieren; Augen schwach nierenförmig, gewölbt, Stirnabstand etwa ½ Augendurchmesser. Halsschild etwas breiter als der Kopf mit den Augen, etwas länger als breit, gewölbt, vorn stark abgerundet, hinten schwach verengt, Vorderrand fein, Hinterrand stark aufgebogen gerandet, Hinterwinkel stark vortretend, Scheibe zerstreut und grob punktiert. Schildchen länglich, Spitze abgerundet, glatt, mit flacher Mittelrinne. Flügeldecken doppelt so breit als die Halsschildbasis, gewölbt, nach hinten schwach erweitert, Schultern kräftig, etwas gefaltet, Spitzen zusammen stumpf zugespitzt, Scheibe am Ende des 1. Drittels etwas flachgedrückt, gestreift-punktiert, Punkte in den Streifen dicht, nach der Spitze zu schwächer, Zwischenräume wenig gewölbt, nach den Seiten und nach hinten stärker, vollständig glatt; Epipleuren schmal, etwas querrunzlig, glatt. Unterseite glänzender, mit Ausnahme der grob punktierten Seiten der Brust und des Abdomens glatt; Abdominalfortsatz ziemlich schmal, Spitze wenig abgerundet, breit gerandet. Beine beim ♂ kräftig, mit kräftig verdickten Schenkeln, beim ♀ viel dünner, Spitze der Hinterschenkel den Hinterrand des 4. Segments überragend, Schienen beim ♀ fast gerade, beim ♂ die Vorder und Mittelschienen ebenfalls, aber die Hinterschienen in der Mitte in eigentümlicher Weise von oben nach unten durchgebogen, auch seitlich gebogen, die Unterseite fast in ihrer ganzen Länge ausgehöhlt, die Höhlung mit langen hellen Haaren besetzt, die Ränder der Höhlung erheben sich vor der Mitte beiderseits zu einem stumpfen, breiten Zahne. Füsse oberseits mit langen hellen Haaren, unterseits mit heller bürstenartig behaarter Sohle. Erstes Tarsenglied der Hinterfüsse so lang wie die folgenden Glieder zusammen.

Länge: 12–14 mm.; Schulterbreite: 3–3.5 mm.

2 ♂ ♂ von LUZON ohne nähere Bezeichnung des Fundortes aus dem Königl. Museum in Berlin.

21. Casnonidea diversipes var. dissimilis nov.

In der Grösse und dem ganzen Bau mit *diversipes* vollständig übereinstimmend, nur in der Färbung stark abweichend. Die Beine mit Ausnahme der dunklen Schenkelspitzen und der Halsschild bräunlich gelb, die Füsse und die Fühler gebräunt. Ein Exemplar hat ebenfalls gelbbraune Flügeldecken.

2 ♀ ♀ von Luzon aus dem Königl. Museum in Berlin.

Die neue Art steht durch die Bildung ihrer Hinterschienen in der Nähe der *C. serra* sp. nov., von der sie sich leicht durch die Färbung und die Bildung der Hintertarsen unterscheidet.

22. Casnonidea concavipes sp. nov.

Sehr gestreckt, nach hinten nicht erweitert, wenig gewölbt, mässig glänzend; hell gelbbraun, Kopf und Flügeldecken bedeutend dunkler, letztere mit bläulichem Schimmer (vielleicht noch nicht ausgefärbt), Fühler nach aussen bedeutend geschwärzt, die letzten Abdominalsegmente angedunkelt; mit sehr spärlichen, abstehenden, langen hellen Borsten. Oberlippe über doppelt so breit als lang, gewölbt, Vorderrand gerade, nach der Basis zu stark verengt, sehr zerstreut punktiert, mit einzelnen langen Borsten; Clypeus etwas länger als die Lippe, stark gewölbt, etwas buckelig, skulptiert wie die Lippe, von der Stirn durch eine tiefe, glatte, gebogene Furche getrennt; Stirn glatt, vorn eingedrückt, Mitte des Scheitels mit einer Grube; Schläfen kurz, grob punktiert. Fühler fadenförmig; die Körpermitte erreichend, 3. Glied etwas länger als das 4., Endglied walzenförmig, wenig gebogen, stumpf zugespitzt, so lang wie die 4 vorhergehenden Glieder zusammen (♂). Augen vorn sehr schwach ausgerandet, gewölbt, Stirnabstand weniger als ½ Augendurchmesser. Halsschild sehr wenig länger als breit, gewölbt, so breit wie der Kopf mit den Augen, Vorderecken wenig abgerundet, Seiten nach hinten wenig verengt; Vorderrand fein, Hinterrand breit und aufstehend gerandet, Scheibe weitläufig und grob punktiert, vor dem Hinterrande quer eingedrückt. Schildchen dreieckig, fein und dicht punktiert, Spitze abgerundet. Flügeldecken parallel, kaum doppelt so breit wie die Halsschildbasis, Spitze zusammen zugespitzt, Skulptur wie bei *C. diversipes* sp. nov., Spitze mit einigen Borstenpunkten; Epipleuren sehr schmal, glatt. Unterseite wie bei *diversipes;* Abdominalfortsatz, ziemlich schmal, stark gewölbt, scharf gerandet, Spitze wenig abgerundet. Beine sehr kräftig, Schenkel stark keulig verdickt, Hinterschenkel fast den Hinterrand des 4. Segmentes erreichend; Vorder- und Mittelschienen fast gerade, Hinterschienen stark 2 mal gebogen, Unterseite der ganzen Länge nach ausgehöhlt und mit langen weisslichen Haaren besetzt, der innere Rand im letzten Drittel der Schienen stark, fast lappenförmig erweitert. Füsse wie gewöhnlich; 1. Tarsenglied der Hinterfüsse etwas kürzer als die folgenden Glieder zusammen.

Länge: 12 mm.; Breite nicht ganz 3 mm.

1 ♂ von SÜD-CELEBES, Bantimoeroeng, gesammelt von *C. Ribbe,* 1882.

Diese Art bildet mit *serra* m. und *diversipes* m. eine charakteristische Gruppe.

NEMOSTIRA Fairmaire

23. Nemostira marginata sp. nov.

Sehr gestreckt, fast parallel, mässig gewölbt, mässig glänzend, mit spärlichen hellen Borsten besetzt; rötlich gelbbraun, Beine und Flügeldecken etwas heller, Augen schwarz, die Naht und ein Streif neben dem Rande fast bis zur Spitze dunkelbraun. Kopf wie gewöhnlich, fast glatt; Oberlippe breit herzförmig, mit einigen langen Borsten, Clypeus vorn gerade, ebenso breit wie die Lippe, ebenso beborstet, stark gewölbt, von der Stirn durch eine breite, flache Grube getrennt; Stirn vorn mit einer stärker punktierten Grube; Schläfen kurz, mit einigen groben Punkten neben den Augen, plötzlich in den Hals verengt; erstes Glied der Maxillartaster messerförmig, Innenrand vor der Spitze ausgeschnitten; Fühler kaum halb so lang wie der Körper, schlank, gleichmässig dick, 3. und 4. Glied gleich, Endglied walzenförmig, wenig gebogen, zugespitzt; Augen nierenförmig, stark gewölbt, grob fazettiert, Stirnabstand geringer als 1 Augendurchmesser. Halsschild etwas länger als breit, so breit wie der Kopf mit den Augen, gewölbt, grob und weitläufig punktiert, vor dem Hinterrande mit einer kleinen Grube, Vorderecken stark gerundet, Seiten nach der Basis zu eingezogen, Hinterwinkel vortretend, Vorder- und Hinterrand gerade, ersterer fein, letzterer breit und aufgebogen gerandet. Schildchen rundlich, glatt. Flügeldecken nicht ganz doppelt so breit wie die Halsschildbasis, Schultern rechtwinklig abgerundet, Spitzen zusammen abgerundet, Scheibe im 1. Drittel flach niedergedrückt, gestreift-punktiert, Punkte in den Streifen grob und ziemlich dicht, Zwischenräume mässig gewölbt, jeder mit einer weitläufigen Reihe grober Borstenpunkte; Epipleuren schmal, fast glatt, Unterseite stark glänzend, nur die Seiten der Brust und des Abdomens grob punktiert, mit einzelnen Borsten; Abdominalfortsatz dreieckig, Spitze rundlich erweitert, breit gerandet. Beine, Spitze der Hinterschenkel den Hinterrand des 3. Segmentes erreichend, Schenkel mässig verdickt, Schienen schwach gebogen. Erstes Tarsenglied der Hinterfüsse nicht ganz so lang wie die folgenden Glieder zusammen.

2 ♂ ♂ und 1 ♀, dem der Vorderkörper fehlt.

Länge: 8–9 mm.

LUZON: Bataan, Lamao (*H. E. Stevens*).

Type ♂, No. 9821 des Bureau of Science, Manila, in meiner Sammlung.

Die Art hat grosse Ähnlichkeit mit *Casnonidea brevicollis* Fairm., zeigt aber ausser dem dunklen Rande der Flügeldecken noch eine dunkle Naht. Bei der neuen Art sind auch die Fühler und die Beine hell; der Halsschild ist länger als breit. Die Flügeldeckensculptur ist sehr ähnlich.

24. **Nemostira melanura** sp. nov.

Sehr gestreckt, parallel, der Länge nach wenig gewölbt, wenig glänzend, rötlich gelb, Kopf und Fühler dunkel rotbraun, Apex der Flügeldecken schwarz mit bläulichem Schimmer, ebenso die Kniee und die Schienen der Vorder- und Mittelbeine, Hinterschienen schwach gebräunt; alle Füsse dunkel; Oberseite fast unbehaart. Kopf wie gewöhnlich. Oberlippe schwach breit herzförmig, zerstreut punktiert, lang gelblich beborstet; Clypeus so lang wie die Lippe, stark gewölbt, glänzend, mit einzelnen Borsten, von der Stirn durch eine gebogene, tiefe, breite Furche getrennt; Stirn und Scheitel mit tiefer Mittellinie, grob punktiert; Schläfen sehr schmal, tief eingeschnürt, Hals vorn schmäler als hinten. Letztes Glied der Maxillartaster schmal dreieckig. Fühler etwas kürzer als die halbe Körperlänge, nach aussen nicht verdickt, Glieder gestreckt, 3. Glied sehr wenig länger als das 4., Endglied so lang wie die 4 vorhergehenden Glieder zusammen; Augen unten und oben stark genähert, nierenförmig, stark gewölbt, Stirnabstand weniger als 1 Augendurchmesser. Halsschild so lang wie breit, breiter als der Kopf mit den Augen, gewölbt, Vorderecken stark abgerundet, Seiten nach hinten verengt, vor den Hinterecken eingeschnürt, so dass die Hinterecken vortreten, Vorder- und Hinterrand etwas ausgeschnitten, vorn fein, hinten breit aufgebogen gerandet, Scheibe grob, zerstreut punktiert, mit deutlicher Mittelrinne und einer Grube vor der Mitte des Hinterrandes. Schildchen länglich, Spitze abgerundet, glatt. Flügeldecken kaum doppelt so breit als der Halsschild an der Basis, Seiten parallel, Spitzen einzeln abgerundet, Schultern gut entwickelt, Scheibe gestreift-punktiert, Punkte in den Streifen gross und dicht, nach hinten feiner werdend, Zwischenräume wenig gewölbt, glatt; Epipleuren schmal, gewölbt, glatt. Unterseite glänzender, fast glatt, nur die Seiten der Brust und des Abdomens mit zerstreuten groben Punkten; Abdominalfortsatz gleichseitig dreieckig, äusserste Spitze abgerundet, ziemlich breit gerandet. Beine, Schenkel gut verdickt, Spitze der Hinterschenkel fast den Hinterrand des 4. Segmentes erreichend,

Vorderschienen stark, Hinterschienen wenig, Mittelschienen gar nicht gebogen, Innenseite lang gelb behaart. Erstes Tarsenglied der Hinterfüsse so lang wie die 2 folgenden Glieder zusammen. Sohle der Füsse bürstenartig behaart.

Länge: 10–12 mm.; Schulterbreite: 3 mm.

NEGROS, Negros Occidental, Maao, Nakalang (*Charles S. Banks*).

Type ♂, No. 245 der Sammlung des Bureau of Science, Manila.

Die Art gehört in die Verwandtschaft von *atriceps* Fairm. Sie ist etwas grösser, hat ein abgerundetes Schildchen, dunkle Kniee, Schienen und Fühler, und ein längeres, anders skulptiertes Halsschild. Auch *atricapilla* Fairm. ist verwandt, unterscheidet sich aber durch die Färbung.

Casnonidea terminata Fairm. ist ebenso gefärbt, ist aber breiter; der Kopf ist so breit wie der Halsschild; die Fühler sind etwas gesägt und haben ein viel kürzeres Endglied. Die Flügeldeckenbildung ist abweichend.

25. **Nemostira melanura** var. **atripennis** nov.

Von gleicher Grösse, Körpergestalt und Skulptur wie *melanura*. Die Färbung ist durchweg dunkler. Die Flügeldecken sind schwarz mit bläulichem Schimmer und nur die Naht ist gelb gesäumt. Die Hinterschienen sind auch dunkel. Das Endglied der Fühler ist so lang wie die 3 vorhergehenden Glieder zusammen.

LUZON, Benguet Sablan (*W. F. Pack*).

Type (♀?), No. 1619 des Bureau of Science, Manila, in meiner Sammlung.

II. ALLECULIDAE

DIETOPSIS Solier

26. **Dietopsis sericans** Fairm.

LUZON, La Laguna, Magdalena (769 und 2847, *W. Schultze*).

Ausser dieser Art sind bisher keine weiteren Arten bekannt.

CISTELOMORPHA Redtenbacher

27. **Cistelomorpha distincticornis** Pic.

28. **Cistelomorpha subcostulata** Fairm.

LUZON, Benguet, Baguio (14873, *F. Worcester*).

29. **Cistelomorpha semipellita** sp. nov.

Oval, nach hinten sehr wenig verbreitert, stark gewölbt, Flügeldecken etwas dachförmig; Oberseite lebhaft gelbrot, letztes Drittel der Flügeldecken schwarz, Fühler mit Ausnahme der

3 roten Basalglieder schwarz (3. Glied an der Spitze gebräunt), Augen schwarz, Unterseite gelb (zuweilen die Brust und der Rand des Halsschildes rötlich), die beiden letzten Hinterleibssegmente glänzend schwarz, die Beine rötlich, die Kniee, die Spitzen der Tibien und der Tarsenglieder schmal gebräunt; mässig glänzend; sehr schwach behaart, der schwarze Fleck der Flügeldecken ziemlich lang, dicht, abstehend, schwarz beborstet. Kopf schmal, mässig dicht, ziemlich stark punktiert; Oberlippe etwa $1\frac{1}{2}$ mal so breit als lang, vorn ausgerandet, gelblich beborstet; Clypeus etwa doppelt so breit wie die Oberlippe, weitläufiger punktiert, in der Mitte mit einem flachen Längseindrucke, von der Stirn durch einen tiefen gebogenen Eindruck getrennt; Stirn gewölbt, glänzender, mit undeutlichen Eindrücken, Einlenkungsstelle der Fühler stark aufgebogen, hinter den Augen ein starker Quereindruck, Schläfen sehr kurz; letztes Glied der Kiefertaster schmal, schief abgestutzt; Augen stark gewölbt, nierenförmig; Fühler etwa gleich der halben Körperlänge, mässig dick, nach aussen nicht erweitert, Glieder gestreckt und an der Spitze schwach nach aussen erweitert, so dass sie etwas gesägt erscheinen, 3. Glied das längste, Endglied seitlich ausgerandet. Halsschild halbkreisförmig, überall fein und scharf gerandet, Scheibe mässig gewölbt, fein und dicht punktiert, vor dem Schildchen mit 3 im Dreieck stehenden schwachen Eindrücken, Vorderecken schwach angedeutet, Hinterwinkel rundlich rechtwinklig, Hinterrand 2 mal gebuchtet, vor den Ausbuchtungen je eine flache Grube. Schildchen dreieckig, abgestumpft, fein und dicht punktiert. Flügeldecken um die Hälfte breiter als der Halsschild, Schultern etwas gefaltet, stark entwickelt, Decken hinten zusammen abgerundet, hinter dem Schildchen etwas flachgedrückt, stark gestreift-punktiert, Zwischenräume stark gewölbt, vorn flach, Scutellarstreif kurz, der Naht sehr nahe, der 2. Zwischenraum nach hinten stark verschmälert, der 3. nach hinten verbreitert, Punktstreifen auf der Schulterbeule erloschen, Zwischenräume überall fein und dicht punktiert; Epipleuren vor der Spitze schwindend, allmählich verengt, fein und dicht punktiert, von den Flügeldecken auch an den Schultern scharf abgesetzt. Unterseite fein punktiert und kurz, fein gelblich behaart, Seiten des Abdomens uneben, ♂ im letzten Abdominalring in der Mitte des Hinterrandes eine flache Grube, Abdominalfortsatz spitz, so lang wie breit, fein gerandet. Beine kurz, Oberschenkel wenig verdickt, Schienen schwach gebogen, innerer Dorn der Hinterschienen fast doppelt so lang als der äussere, beide dünn

und spitz; 1. Tarsenglied der Hinterfüsse so lang wie die 2 folgenden Glieder zusammen.

Länge: 13–15 mm.; Schulterbreite: 6–7 mm.

LUZON, Benguet, Baguio (*F. Worcester*).

Type ♂, No. 11345 des Bureau of Science, Manila, in meiner Sammlung.

Die Art hat eine gewisse Ähnlichkeit mit *C. calida* All., ist aber breiter und weicht in der Färbung bedeutend ab. Von den Arten mit gefleckten Flügeldecken unterscheidet sie sich durch ihre Breite und Grösse und hauptsächlich durch die starke Behaarung des schwarzen Fleckes.

30. **Cistelomorpha anaematica sp. nov.**

Länglich-oval, gewölbt; nicht glänzend; schwefelgelb, Flügeldecken weisslich gelb, Augen und Fühler mit Ausnahme der ersten Glieder schwarz, Klauen und Dorne der Schienen gebräunt, zuweilen die beiden letzten Hinterleibsringe schwach rötlich; der ganze Käfer mit Ausnahme der etwas länger behaarten Schienen fein anliegend, kurz, gelb behaart. Kopf gestreckt, fein und dicht punktiert, Oberlippe vorn ausgerandet, Clypeus nicht breiter als die Lippe, Schläfen sehr kurz; letztes Glied der Kiefertaster fast walzenförmig, Spitze leicht gebräunt, letztes Glied kaum länger als das vorhergehende; Augen nierenförmig, gewölbt, Abstand auf der Stirn nicht ganz 2 Augendurchmesser, von oben gesehen. Fühler halb so lang wie der Körper, nicht verdickt, schwach gesägt, 3. Glied 1½ mal so lang wie das 4., Endglied an der Seite ausgerandet. Halsschild fast so breit wie die Flügeldecken, halbkreisförmig, sehr fein und sehr dicht punktiert, gewölbt, sonst wie bei der *C. semipellita* sp. nov. aber ohne die Eindrücke. Schildchen wie bei *semipellita.* Flügeldecken 2½ mal so lang als breit, an der Spitze zusammen abgerundet, beim Schildchen etwas flachgedrückt, gestreift-punktiert, Punkte nach hinten undeutlich werdend, Scutellarstreifen kurz, sehr undeutlich punktiert, Zwischenräume gewölbt, sehr fein und sehr dicht punktiert, 2. Zwischenraum schmal, 3. breit und so abwechselnd; Epipleuren wie bei *semipellita.* Unterseite fein punktiert, Seiten des Abdomens uneben. Abdominalfortsatz schmal, spitz, fein gerandet. Beine wie bei *semipellita,* Dorne der Hinterschienen dünn und spitz, innerer Dorn etwas länger als der äussere; 1. Tarsenglied der Hinterfüsse länger als die 2 folgenden Glieder zusammen.

Länge: 12 mm.; Schulterbreite: 4.5 mm.

LUZON, Bataan (*E. D. Merrill*).

Type, No. 1124 des Bureau of Science, Manila, in meiner Sammlung.

Diese Art hat viel Ähnlichkeit mit *flavovirens* Fairm., aber die bedeutendere Grösse und die verschiedene Skulptur der Flügeldecken scheiden sie. Sie hat auch Ähnlichkeit mit *hypoxantha* Fairm., aber ausser durch ihre Grösse weicht sie durch die nicht schwarzen letzten beiden Adbominalsegmente ab.

31. Cistelomorpha rufiventris sp. nov.

Länglich, gewölbt, glänzend; schwefelgelb, die stärker erhabenen Zwischenräume der Flügeldecken heller, Abdomen rötlich, Augen und Fühler mit Ausnahme der beiden Grundglieder schwarz, Schienen und Füsse, letztes Glied der Kiefer und Lippentaster braun; der ganze Käfer sehr fein und kurz anliegend gelb behaart. Kopf sehr gestreckt, Oberlippe quer, stark glänzend, sparsam punktiert, vorn ausgerandet, Clypeus ebenso skulptiert, doppelt so lang wie die Oberlippe, von der Stirn durch eine tiefe, gebogene Furche getrennt, Stirn gewölbt, uneben, stärker punktiert, Schläfen nicht vorhanden, Hals fast so breit wie der Kopf; letztes Glied der Kiefertaster so lang wie das vorletzte, nach aussen mässig erweitert, schief abgestutzt; Fühler etwa gleich der halben Körperlänge, schwach gesägt, 3. Glied um die Hälfte länger als das 4., Endglied an der Seite stark ausgerandet; Augen nierenförmig, stark gewölbt, Stirnabstand gleich 2 Augendurchmessern. Halsschild fast halbkreisförmig, gewölbt, fein und sehr dicht punktiert, überall fein gerandet, Scheibe hinten mit schwach angedeuteter Mittelfurche, Vorderwinkel schwach angedeutet, Hinterwinkel rechtwinklig, etwas vortretend, Hinterrand 2 mal gebuchtet, vor den Ausbuchtungen je eine kleine Grube; Schildchen dreieckig, Spitze abgerundet, fein und dicht punktiert; Flügeldecken wenig breiter als der Halsschild, nach hinten schwach erweitert, Spitzen zusammen abgerundet, gestreift-punktiert, Scutellarstreif kurz, die äusseren Streifen schwinden zum Teil vor der Spitze, Punkte in den Streifen dicht, Zwischenräume sehr wenig gewölbt, die ungeraden etwas erhabener und heller, alle sehr fein und dicht, punktiert; Epipleuren durch eine scharfe Kante von den Decken abgesetzt, schmal, reichen fast bis zur Spitze, sehr dicht, etwas runzelig punktiert. Unterseite fein und sehr dicht punktiert, Abdomen stark glänzend, an den Seiten uneben, letzter Ring mit einer tiefen dreiekigen Grube vor der Spitze. Abdominalfortsatz gleichseitig dreieckig, spitz, ziemlich breit gerandet. Beine, Schenkel schwach verdickt, Schienen

wenig gebogen, Spitze des Hinterschenkels erreicht den Hinterrand des 4. Hinterleibsringes, 1. Tarsenglied der Hinterfüsse fast so lang wie die folgenden Glieder (ohne Klauen) zusammen, Dorne der Hinterschienen dünn, gerade, der innere länger als der äussere.

Länge: 10 mm.; Schulterbreite: 3.5 mm.

SIBAY ISLAND (*D. C. Worcester*).

Type ♂, No. 11407 des Bureau of Science, Manila, in meiner Sammlung.

Diese charakteristische Art zeichnet sich von ihren Verwandten durch den vollständig rötlichen Hinterleib und die abwechselnd stärker erhabenen Flügeldeckenzwischenräume aus.